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FIG CULTURE IN CALIFORNIA

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FIG CULTURE IN CALIFORNIA

IRA J. CONDIT[1]

HISTORY

The common fig, *Ficus carica,* a native of the Old World, was early introduced into tropical America. Joseph Acosta, who visited Mexico in 1586, enumerates figs, pomegranates, vines, olives, and mulberries among the plants he found there. Fig trees were found by Vancouver in the Mission garden at Santa Clara in 1792 and at Ventura in 1793. Gardens at the San Gabriel Mission in 1829 included numerous fig trees. The variety of fig grown at the Missions was undoubtedly the black fig now known as Mission.

Near the middle of the Nineteenth Century settlers in California and local nurserymen began to receive cuttings and rooted trees of a considerable number of fig varieties from the eastern United States and from Europe. James Stewart, of Downey, Los Angeles County, had fig trees twelve years old in 1886 and was experimenting with many different varieties. At about the same time Messrs. Barnard and Benedict of Los Angeles wanted 200 tons of figs for a crystallizing process but could not find them, although they offered $50 a ton f.o.b. for them.

Commercial fig orchards appear to have been established in the coast counties, and even in the Sacramento Valley and the Sierra Foothills, earlier than in the San Joaquin Valley. In 1876 there were 18,673 trees in Yolo County, 17,000 in Tuolumne, and only 685 in Fresno County.

An orchard of 27 acres of White Adriatic fig trees was planted at Fresno about 1885, the first carload of dried white figs being sent east in 1889. The White Adriatic was the most widely planted variety during the two decades following 1885 but the dried product lacked the tenderness of skin and the flavor of the imported fig from Smyrna. The Yearbook of the United States Department of Agriculture for 1897 stated that the White Adriatic "has many points of merit, but the fact that its quality when dried is inferior to that of the imported dried fruit from Smyrna has resulted in several efforts to introduce and grow the Smyrna type of fig."

The first introduction of cuttings of the true Smyrna fig into California was made in 1880 by the late G. P. Rixford, who was then business manager of the Evening Bulletin, San Francisco. Two years later an-

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other shipment of 14,000 cuttings including several varieties of the Smyrna type was received, a large number being distributed to subscribers of the newspaper. Governor Leland Stanford cooperated in the venture and planted an allotment of cuttings on his ranch at Vina, where a number of the original trees are still growing. More detailed accounts of the introduction of the Smyrna figs are given by Dr. Gustav Eisen[2] and by Mr. Rixford[3] himself.

In 1886 the Fancher Creek Nursery of Fresno obtained from Smyrna several thousand fig cuttings including the principal drying variety, some of the most promising varieties for fresh-fruit production, and a few varieties of caprifigs. An importation of fifty well-rooted four-year-old Smyrna trees was made by the California State Board of Horticulture in 1890 and widely distributed over the state. Trees imported by the various agencies grew vigorously enough but as the fruit invariably dropped when about the size of a marble, there developed a widespread suspicion that cuttings of some worthless variety rather than those of the true Smyrna fig had been secured. E. W. Maslin of Loomis therefore raised seedlings grown from seeds of imported Smyrna figs and planted them on his ranch in 1887. These seedling trees thrived but their fruit also failed to set and mature.

It had long been known that the successful production of the Smyrna fig in Asia Minor and elsewhere was made possible by transferring fruits from the caprifig tree to the tree of the Smyrna type at the proper time. This resulted in the carrying of pollen to the latter by a small insect known as the fig wasp. There was considerable controversy over the necessity for pollination or caprification of the Smyrna fig, although Dr. Eisen knew of the process and explained it in detail. The State Board of Horticulture even published in 1891 the results of an investigation of common figs in Italy by Gasparrini, who concluded that "caprification is useless for the setting and ripening of fruit and therefore this custom, which entails expense and deteriorates the flavor of the fig, ought to be abolished . . . . " By transfering pollen from the caprifig to the flowers of the Smyrna fig by means of a toothpick, George Roeding of Fresno proved to the skeptical in 1890 that pollination of the Smyrna fig is a necessary prerequisite to fruit setting. The following year by using a glass tube drawn out to a fine point, he succeeded in getting one hundred and fifty figs to set and mature excellent fruit. This and similar experiments by Dr. Eisen showed that caprification is not simply a superstitious practice of ignorant peasants, and interest was stimulated

[2] Eisen, G. The fig. U. S. Dept. Agr. Div. Pomology Bul. 9:1–317. 15 plates, 93 figs. 1901. (Out of print.)

[3] Rixford, G. P. Smyrna fig culture. U. S. Dept. Agr. Bul. 732:1–43. 12 figs. 1918.

in the attempts to introduce the fig wasp or blastophaga into California. This was accomplished in 1899, caprifigs containing blastophagas having been shipped from Algiers by W. T. Swingle, who was commissioned by the United States Department of Agriculture for this express purpose. In 1900 the crop of Smyrna-type figs on the Roeding place at Fresno amounted to 12 or 15 tons, only about one-half of which was harvested, however, the remainder being lost through splitting, bird damage, and souring during early rains.

The successful introduction of the blastophaga naturally stimulated interest in the commercial production of the Calimyrna (California Smyrna) fig, a name suggested as the result of a $25 prize offered by George Roeding for the most distinctive name of the variety in California. In 1902 the Ceres Fig Lands Company promoted the Smyrna Park colony, stating in its circular: "No horticultural event since the discovery and propagation of the navel orange can compare in commercial importance to the recent establishment of Smyrna fig culture in California. Its successful introduction into the state marks a new epoch in our fruit interests and those who engage in it first will reap large profits." Small orchards were planted by individual growers in several parts of the San Joaquin Valley and a few larger plantings were made by promotion companies.

Since about 1915 the acreage of figs in California has rapidly increased. Interest in commercial fig culture was stimulated by the possibility of developing a large outlet for figs as a canned or preserved product, by the successful shipment of fresh figs in carlots to eastern markets, and by the organization of the California Peach and Fig Growers for the cooperative marketing of fig products. The Peach and Fig Growers deserves credit for initiating the study of fig-spoilage diseases, for helping to secure a higher tariff on imported figs, for insisting upon stricter pure food tolerances for figs and fig products, and for sponsoring educational meetings or institutes of growers.

An annual Fig Institute,[4] the first meeting convening in 1917, is held at various places in the San Joaquin Valley and provides a forum for the discussion of practical problems facing the growers. The 16th meeting was held at Fresno, November 4, 1932. Steps have recently been taken to form a permanent Fig Institute association to arrange for the annual meetings and to promote activities looking to the improvement of the industry.

[4] Proceedings of the Fig Institutes have been published as follows: 1st, 1917, by the J. C. Forkner Fig Gardens, Fresno; 6th, 1922, by the California Peach and Fig Growers, Fresno; 10th, 1926, mimeographed by the Fresno County Farm Bureau; 13th, 1929, by the County Agricultural Commission, Merced. Copies of the 13th Proceedings are still available.

BOTANY AND CLASSIFICATION OF FIGS

The common fig belongs to the mulberry family, Moraceae, and to the genus *Ficus,* which includes more than 600 species. Most species of *Ficus* are tropical evergreens of importance only for ornamental or for reforestation purposes. *Ficus carica,* the common fig, furnishes the fresh and dried figs of commerce. *Ficus pseudocarica* and *Ficus palmata* are grown in a limited way for the production of caprifigs.

The fruit, called the fig, is a fleshy, hollow receptacle bearing flowers on the interior surface. At the apex of all figs is an ostiolum, or mouth, which is usually more or less closed by scales. Within certain receptacles of most, if not all, species of *Ficus* are various species of insects, whose larvae develop from egg to adult inside the individual flowers. A fig flower, the ovary of which contains the egg or larva of a fig wasp, is termed a gall flower. When the blastophaga, or fig wasp, emerges from the gall flower and leaves the fig, it may be dusted with pollen if the staminate flowers near the ostiolum are mature at that time. Such pollen is carried to other figs into which the insects enter to oviposit, and pollination is thus unwittingly accomplished.

Types of the Fig and Differentiation of Fruit Buds.—There are four general horticultural types of *Ficus carica.* The most primitive of these, the caprifig, has flowers with short-styled pistils (fig. 1); the other three types (the Smyrna, White San Pedro, and the common) have flowers with long-styled pistils.

Trees of the caprifig type characteristically produce three series of fruit buds each growing season. The first series of buds gives rise to the *profichi* or spring crop, the second series to the *mammoni* or summer crop, and the third series to the *mamme,* or winter crop. The number of the series of fruit buds, however, depends upon climatic conditions. For instance, the cool climate of Berkeley retards the development of figs and only two series of buds mature, the mammoni crop being omitted; in the warmer climate of the Fresno district, development is more rapid and a second mammoni crop appears in late summer; in the extremely hot climate of Imperial Valley, there are said to be seven more or less distinct generations of the blastophaga developing in as many crops of the caprifig tree.

Trees of the three fig types (Smyrna, White San Pedro, common) bearing long-styled flowers (fig. 1) have the first series of buds maturing into a breba crop corresponding to the profichi of the caprifig; the second series of buds develops into the main crop, corresponding to the mammoni of the caprifig. Fig trees of the common type occasionally produce a

third series of buds which may mature the same season, may be destroyed by frost, or may remain dormant during the winter and mature the following spring. The development of these fruit buds depends upon the horticultural variety, the temperature, and the length of the growing season. Thus, trees of the Kadota and Turkey varieties are especially

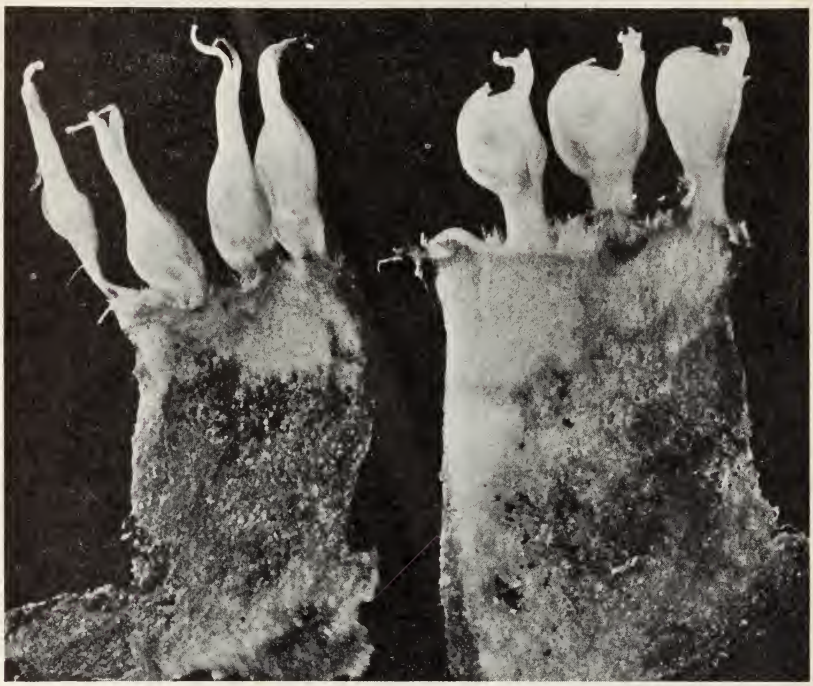

Fig. 1.—Fig flowers: left, long-styled flowers of the edible fig; right, short-styled gall flowers of the caprifig. (From Bul. 506.)

prolific and figs continue to develop until the cooler weather of fall induces dormancy. Some varieties have one, or frequently two fruit buds and a vegetative bud, axillary to nearly every leaf. Other varieties have the fruit buds more scattered and borne in the axils of occasional leaves only.

The Caprifig Type.—The caprifig indigenous to southwestern Asia, is the primitive type of cultivated fig, and the three types of edible figs have undoubtedly evolved from this type. The short-styled flowers of caprifigs are adapted to oviposition by the fig wasp (*Blastophaga psenes* L.) and receptacles of the three crops of the caprifig tree harbor the larvae, pupae, or temporarily the adults of this insect. The presence of the immature blastophagas in mammoni and mamme figs is usually essential to their proper development on the tree, and caprifigs which

lack such blastophaga usually fail to develop to maturity. In some horticultural varieties of the caprifig, however, the profichi crop maturing in May or June consists of two kinds of figs, those with and those without larvae in the gall flowers. Figs inhabited by wasps normally keep green

Fig. 2.—The largest figs in the illustration are mamme figs from which the blastophagas are issuing. The four smaller figs at the tip of the branch are profichi figs of sufficient size for the female insects to enter and to oviposit in. Note the female blastophagas on the surface of the fruit. (From Bul. 506.)

and plump until maturity and are designated as "insectiferous" figs. On the same tree other figs not inhabited by wasps develop with an abundance of pollen and are known as "polleniferous" figs or "blanks." The latter are of no horticultural value since the blastophagas are not present to distribute the pollen.

The seasonal history of the blastophaga in the San Joaquin Valley is as follows: the larvae hibernate in figs of the mamme crop, change to pupae in March, and emerge as adults in April (fig. 2). Eggs laid in the

profichi in April develop into adult blastophagas that oviposit in figs of the mammoni crop early in June. Eggs laid in the mammoni figs early in June have, by the end of July, developed into mature blastophagas which oviposit in figs of the second mammoni crop. These second mammoni figs may mature during late summer or early fall or may persist on the trees and constitute the mamme crop from which adult blastophagas emerge the next spring.

Development of the blastophaga larva is correlated with purplish or violet coloration of the flower parts in some varieties of the caprifig, such as Milco and Samson. In other varieties such as Stanford, and in all caprifigs of *Ficus pseudocarica* and *Ficus palmata* thus far observed, the flower parts are white or greenish yellow in all stages of gall-flower development.

Pollination of the flowers of Smyrna figs with pollen carried to them by blastophagas from the profichi crop of caprifigs is called caprification. Man modifies the normal life history of the blastophaga by placing mature profichi of the caprifig in fig trees of the Smyrna type and thus causing pollen-dusted blastophagas to enter Smyrna figs instead of caprifigs. The female blastophagas, which generally lose their wings as they push their way between the scales of the ostiolum, crawl over the long-styled flowers in a vain attempt to deposit their eggs. Pollination is thus accomplished. Eventually the insect emerges from or dies within the receptacle.

Caprifigs are the only figs which bear mature stamens. The staminate flowers are abundant at the apical end of figs of the profichi crop but in *Ficus carica* caprifigs are scarce or lacking in figs of the mammoni and mamme crops. In the two species, *Ficus pseudocarica* and *Ficus palmata,* the figs of all three crops contain staminate flowers. As the stamens mature six or eight weeks after the stigmas of the pistillate flowers in the same fig are receptive to pollen, self-pollination is impossible.

The Smyrna Type.—Figs of the Smyrna type mature only after the pollination of their long-styled flowers and a resultant development of seeds. Without such stimuli the immature figs of both the breba and main crops usually shrivel and drop when about an inch in diameter. Sometimes a few brebas develop without this stimulus. The fertile seeds account for the excellent quality of Smyrna figs. Varieties belonging to this type include Calimyrna, Kassaba, and Bardajic.

The White San Pedro Type.—Figs of the White San Pedro type combine the characteristics of both the Smyrna and the common type on one tree: brebas are of the common type and develop without pollination of

the flowers; second-crop figs are of the Smyrna type and drop unless they are caprified. Examples of varieties belonging to this type are the White San Pedro and the Gentile, neither of which is grown commercially.

The Common Type.—Figs of the common type do not require caprification in order to have the fruit mature. Varieties of this type are the Mission, Adriatic, Kadota, and Turkey. The flowers of common figs were once regarded as incapable of being caprified and were therefore designated by Eisen as mule flowers, but G. P. Rixford and others have proved that probably all common figs can produce fertile seeds if the flowers are caprified.

VARIETIES OF FIGS

Six varieties of figs are grown commercially in California, all of which originated in the Old World. They are, in the order of their commercial importance, Adriatic, Calimyrna, Kadota, Mission, Turkey, and Brunswick.

Adriatic (*White Adriatic, Grosse Verte, Nebian*).—The Adriatic is said to have been introduced by W. B. West of Stockton from an English nursery in 1865, but was exploited several years later by G. N. Milco under its present name. Since about 1884 it has been and still is the principal drying fig of California, although the dried product is not of high quality. The trees are vigorous, very productive, and thrive with little care. Brebas are few in number, large, pear-shaped, green, and have deep strawberry-red pulp and rather strong flavor. In interior districts second-crop figs are medium in size, variable but generally spherical or top-shaped, green, have light-strawberry pulp, strong fig flavor, and are rich and good when well ripened; seeds are numerous and hollow. In coastal districts second-crop Adriatic figs are large, green with a purple tinge, deep blood-red inside, and have an excellent flavor. When caprified, Adriatic figs are medium to large, and have a deep-red pulp and somewhat acid flavor.

Calimyrna (*Lob Injir*).—The Calimyrna is identical with the principal drying fig of the Smyrna district, whence it has been introduced several times. It is of high quality for fresh consumption locally, for distant shipment, and for drying. The Calimyrna probably exceeds the Adriatic in acreage now but not in production. The brebas mostly drop immature for lack of caprification, but in some seasons a sufficient number set and mature to warrant their shipment to the fresh-fruit market. Second-crop figs are large, onion-shaped, greenish or lemon-yellow, and have amber or light-strawberry pulp and rich flavor; seeds are large, numerous, and fertile.

Kadota (Dottato, White Endich, White Pacific, Clarkadota).—The Dottato fig was received by J. E. Cutter of Riverside about 1889 through the United States Department of Agriculture. It attracted attention after a few years' trial on account of its resistance to souring, and in 1898 was distributed by S. H. Taft of Sawtelle under the name of Kadota. Since 1920 hundreds and even thousands of acres of this variety have been planted as the Clarkadota fig, being wrongly exploited as an improved strain or bud sport of the original Kadota. The Kadota is identical with the Dottato of Italy, where it is the principal drying variety. In California it has been planted mainly for fresh fruit canning to which it is excellently adapted, but in recent years large tonnages have been dried.

Brebas are large, green, pear-shaped, and have a violet-tinted pulp and rich flavor. Second-crop figs are of medium size, globular or oval, yellowish green to lemon-yellow when mature, and have an amber seedless pulp, sweet but somewhat lacking in character.

Caprification materially changes both external and internal characters of the ripening fruit. Uncaprified Kadota figs are normally of medium size, of lemon-yellow color, have amber pulp, are practically seedless and of good canning quality. Caprified Kadota figs are large, green in color, strawberry-red in pulp, seedy, and undesirable or worthless for canning, but good for drying.

Mission (Black Mission, California Black, Franciscana, Negra).—The Mission fig is identical with a variety grown under various names in southern Spain, whence it was early brought to America. The late George Roeding once said: "The only trouble with the Mission fig is its color," a statement which is still applicable to the variety. It is an excellent fig both fresh and dried, but the black color is objectionable to the baking trade and to eastern dried-fruit markets. Brebas are large, pear-shaped, purplish black, and have light-strawberry pulp and sweet rich flavor; excellent for local and distant fresh-fruit markets. Second-crop figs are medium-sized, oblong or pear-shaped, black with purplish bloom; the pulp is light strawberry, with a pronounced but rich fig flavor; seeds are fairly numerous and hollow. Caprification changes the color of the pulp to a deep strawberry-red, and improves the quality of the dried fig if it is unaffected by spoilage diseases.

Turkey (Brown Turkey, Black Douro, Black San Pedro).—This variety has been grown in England for two centuries or more for forcing in pots and for open-air culture. It is also grown in Spain under various names. In California it is best known in the Coachella Valley and in the vicinity of Los Angeles for its heavy production of large figs (fig. 3) for

the fresh-fruit market. It is practically worthless as a dried fig, and on account of its susceptibility to souring is seldom grown in the San Joaquin Valley. Brebas are large to very large, pear-shaped, brownish black, and have light-strawberry pulp. Second-crop figs are medium to

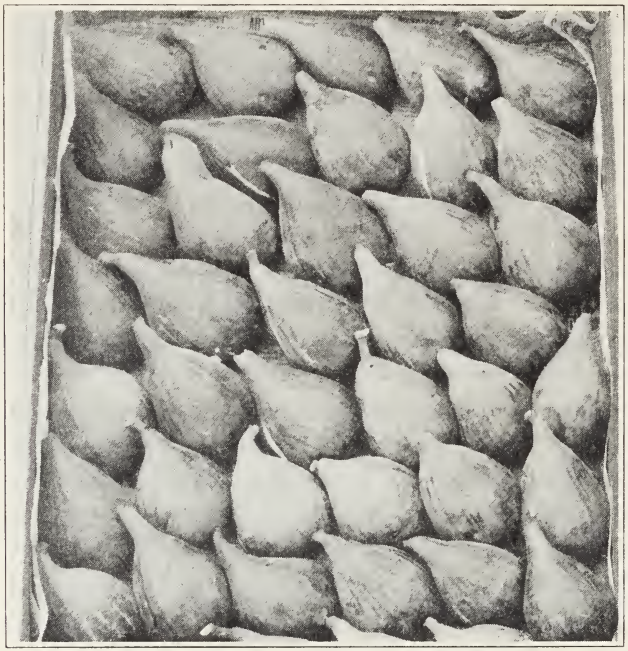

Fig. 3.—Figs of the Turkey (Brown Turkey) variety reach a larger size than those of any other fig grown in California. The fruits illustrated are from vigorous trees and are typical of the Turkey figs found on the Los Angeles market during the summer season.

large, or very large if on vigorous wood, oblique bell-shaped, purplish black to reddish purple, and have light-strawberry pulp hollow at the center, and flat or insipid flavor; flowers are often dry and brown on account of the open eye. The Turkey is sometimes erroneously called Brunswick.

Brunswick (Magnolia).—The Brunswick fig has long been grown in England, although not so commonly as the Turkey. It is characterized by narrowly lobed leaves especially in the foliage of sucker wood. The Brunswick has long been grown in Texas as a canning and preserving fig under the name of Magnolia. During the past two decades large acreages have been planted by promoters and numerous canneries have been established in that state. A few small orchards of the Brunswick are to be found at Elk Grove, California, the figs being regarded by one preserv-

ing company as equal to the Kadota in quality. Individual trees are common in dooryards, but under the same conditions are much less vigorous and productive than the Kadota. Brebas are very few in number, large, very oblique pear-shaped, reddish brown, and have light-strawberry pulp and rather coarse texture. Second-crop figs are medium, spherical or top-shaped, reddish brown, and have amber seedless pulp and sweet flavor. Caprified Brunswick figs are above medium in size, purplish brown, and have deep-strawberry pulp and large fertile seeds.

Figs for Home Orchards.—All of the varieties named above are well adapted to home-orchard culture, although the Calimyrna or other Smyrna-type figs should be planted for this purpose only in case caprifigs are readily available. There are a few other varieties worthy of trial for certain purposes or districts. Trees of Osborn's Prolific or Ronde Noire produce large reddish-brown figs in abundance and of especially good quality around San Francisco Bay and along the coast. The Celeste, a small violet-purple fig grown to some extent in Louisiana for preserving, is also good for that use in parts of this state. The Croisic or Cordelia fig is an edible caprifig which in cool coastal sections matures an early profichi and sometimes a mammoni crop. Trees are common in the San Francisco Bay district and are planted in a small way commercially in Oregon, but the figs are of doubtful quality compared to those of better varieties. The tree of Drap d'Or is rather weak and sometimes inclined to drop its fruit, but the large brick-red brebas are of excellent flavor and quality.

White Genoa is a large yellowish-green fig which does well in some coastal districts but has no place in warm interior valleys. White Marseilles bears two crops of greenish-yellow figs of fair quality in such a climate as Riverside, but can hardly compete with better varieties. The Black Ischia produces figs almost identical with but much smaller than the Mission and therefore inferior. The White Ischia tree is fairly common in California and exceedingly productive, but the figs are too small and perishable to have any special value. The Pastiliere was recommended by Eisen in 1901 as the best black fig for California planting; it has produced abundant crops of excellent fruit at Point Loma but is decidedly inferior to the Mission in most parts of the state. The White San Pedro produces large green figs of no particular merit. The Gentile is similar to it, and of better quality at Hayward, but not in the interior valleys. Verdal Longue produces few if any brebas but a very prolific second crop of green figs continuing to mature late in the season, therefore especially adapted to southern coastal sections having a mild fall and winter climate.

Varieties of Caprifigs.—The following varieties of caprifigs all have purplish or violet-colored pulp when the gall flowers are inhabited by the blastophaga: Roeding No. 1, No. 2, No. 3, and No. 4, Milco, Samson (Markarian No. 1), Kearney, Forbes, and Excelsior.

Roeding No. 3 (fig. 4) is the best of these varieties; the tree produces mamme and profichi abundantly and the latter are large and readily colonized.

Roeding No. 1 (fig. 4) is very prolific and generally carries a good mamme crop, its main fault being the production of numerous polleniferous or "blank" profichi. Roeding No. 2 is now seldom planted, for it carries few if any mamme figs. Roeding No. 4 matures profichi later in the season than the other Roeding varieties. Milco (fig. 4) is a standard variety but rather erratic in its production of fertile galls. Samson succeeds well, especially at Merced, but in some seasons fails to mature viable pollen. Kearney, Forbes, and Excelsior are California seedlings distributed by the late G. P. Rixford, the first two being especially productive of mammoni figs and the third bearing the largest profichi of any named variety.

Stanford, Markarian, *Ficus pseudocarica*, and *F. palmata* all have white pulp. Stanford (fig. 4) is an excellent variety but observations in recent seasons seem to indicate that its profichi are not so attractive to the blastophaga and therefore not so readily colonized as Roeding No. 3. Markarian should no longer be planted because it is weak in both mamme and profichi crops. *Pseudocarica* has no especial merit, being inferior in practically all respects to *palmata*. An entire-leaved form of *palmata* is especially valuable for its mammoni crop, the figs maturing in numbers over a long season.

Production of Improved Varieties.—The need for better varieties of figs was long ago recognized and led to the introduction of the Smyrna-type fig in 1880. With the exception of the three caprifigs specified as California seedlings, every one of the varieties described above undoubtedly originated as a seedling in the Old World centuries ago. Among the figs in the Maslin seedling orchard at Loomis are some both of the Smyrna and of the caprifig type, which have desirable characteristics. About twenty years ago, W. T. Swingle and G. P. Rixford of the United States Department of Agriculture distributed hundreds of seedling figs to growers for trial and among them have appeared a few improved varieties of caprifigs. At the Citrus Experiment Station, Riverside, the Division of Subtropical Horticulture of the University of California is growing and fruiting about three thousand seedling figs of known parentage, and other crosses of desirable combinations will be made from

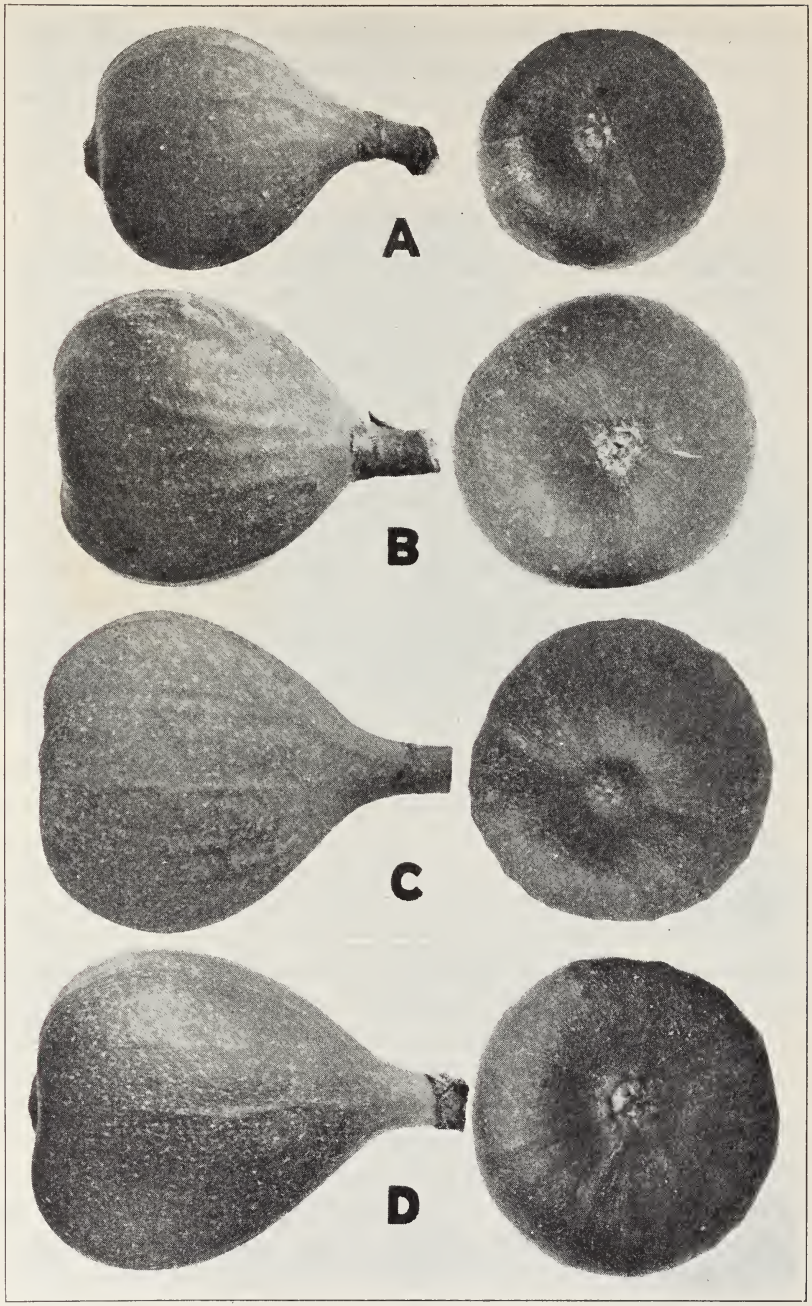

Fig. 4.—Four common varieties of caprifigs grown in California: *A*, Roeding No. 1; *B*, Milco; *C*, Roeding No. 3; *D*, Stanford.

time to time. A good white fig of the common type, resistant or immune to spoilage diseases and having the desirable qualities of the Mission both for fresh fruit and for drying, is especially desired. Growers should be on the lookout for bud sports or seedling figs showing improved characters.

FIG DISTRICTS IN CALIFORNIA

The largest commercial plantings of figs in this state are located in the San Joaquin Valley, almost three-fourths of the acreage being found in the five counties of Stanislaus, Merced, Madera, Fresno, and Tulare. The concentration of over 40,000 acres of figs in this area is due to the climatic factors of hot sunny days and low humidity which favor sun-drying of the crop and the production of good-quality fresh fruit for distant shipment and for canning. Adriatic trees planted as a border around vineyards are a common feature especially in Fresno County. The climate of the delta district of the Sacramento and the San Joaquin rivers, being influenced by the fog and the cool air of San Francisco Bay, has a smaller number of total heat units and relatively greater humidity than the above counties; consequently the main crop of figs starts ripening later, the picking season of canning figs is shorter, and susceptibility to fruit-spoilage diseases is greater than in valley districts north or south.

That foothill districts of the Sacramento Valley are especially adapted to the culture of the Mission fig is evidenced by the fact that trees of this variety, although practically wild, have been thriving and producing bountiful crops ever since the advent of the early miners. Mission fig orchards are especially common in Yolo and Solano counties from Vacaville north to Esparto. Adriatic fig orchards have long been producing successfully in the vicinity of Yuba City and Marysville. The Calimyrna fig is found in small plantings at Corning, Orland, and Oroville, but in this district there is little justification for increasing the acreage of the Calimyrna, since it ripens later than the Adriatic and is therefore more susceptible to damage by early rains and is difficult to caprify in isolated and in windy sections.

In the immediate vicinity of San Francisco Bay fig trees of such varieties as Mission, Osborn's Prolific, and Cordelia mature fruit satisfactorily in ordinary seasons. In the coastal districts farther south fig orchards and individual trees usually produce excellent fresh fruit for local consumption. In Los Angeles County there is a considerable acreage of fig orchards, principally of the Turkey variety, as well as innumerable dooryard trees of Kadota, Mission, and other varieties. Small

plantings of Turkey in the desert area of the Coachella Valley produce figs over a remarkably long season, the first crop ripening for two or three weeks in May, the second crop ripening during the hot summer months, and a third crop maturing from about the first of November until the middle of December. The Mission and the Calimyrna varieties are both planted in a small way in the Coachella and Imperial valleys.

Fig. 5.—Very large Mission fig tree near Corning.

Extensive plantings of the Kadota fig during the past few years have emphasized the fact that the areas in which fig culture can be prosecuted successfully have rather definite limits. Some decidedly unfavorable districts for fig culture are: those in which fall, winter, or spring frosts kill back young trees severely year after year; those where the soil is alkaline and saline water only is available for irrigation; those having light sandy soils infested with nematodes; and excessively windy sections. Tragic mistakes in locating fig orchards could have been avoided had prospective investors first availed themselves of information regarding these limiting factors in fig production. Consultation with the county farm advisor as to local soil, water, and climatic conditions is recommended.

Elevation.—Fig trees thrive in California in depressions of 100 feet or more below sea level up to elevations of over 3,000 feet in the foothills. In Eldorado County some fig trees produce successfully at 3,000 feet elevation, but 2,500 feet seems to be about the upper limit for com-

mercial plantings. Large producing fig trees are to be found at Gold Run in Placer County at an elevation of 3,300 feet; at Forbestown, elevation 2,400 feet, and Paradise, 1,800 to 2,000 feet, both in Butte County; and at Rackerby in Yuba County at 1,400 feet elevation.

Large Fig Trees.—Of the fruit trees introduced into California by the Mission fathers the fig surpasses all others in size of trunk and spread of branches. A Mission fig tree on the W. N. Curtner place near Warm Springs is reported to have been planted about 1800 by Don Higuera. On the old Wolfskill place near Winters there are some immense Mission fig trees planted in 1854. A tree at Woodbridge is noted for its widespread branches, which droop to the ground and form a circle 310 feet in diameter. A White San Pedro tree at Parlier and a Mission tree at Live Oak each have widespreading branches supported on trellises. On the T. Roebuck place, Knight's Ferry, are some Mission fig trees over eighty years old, one of them measuring over 12 feet in circumference a foot from the ground. Other extremely large Mission trees are located on the Moulton ranch near Yuba City; on the old Westrobe place north of Oroville (one branch of this tree still shows initials cut into the bark in 1887); at the John Wolfson home near Merced; and three on the Rydberg place at Cooperstown. One of the largest fig trees in the state (fig. 5), is on the Henry Clark place, near Corning. In 1919 it measured 13½ feet in trunk circumference 2 feet above the ground and had a spread of branches of about 60 feet.

CLIMATIC CONSIDERATIONS

Frost.—The fig tree is a deciduous subtropical, a native of arid, semi-desert regions of the Old World, where its successful culture is limited more by low temperatures of winter than by the high heat of summer.

Young fig trees are very susceptible to frost injury (fig. 6). In widely separated regions in California trees from one to three or four years of age have frequently been frozen to the ground, hundreds of acres of trees having thus been ruined or given a serious setback. Experience has shown that there are three seasons when serious frost damage may occur: the fall season during October and November while the foliage is still green, the dormant winter period, and the season of early spring when the new growth is appearing. The most serious but fortunately the most infrequent damage is done by spring frosts, young fig trees sometimes being thus killed root and all. Both brebas and profichi are sometimes seriously injured or even entirely ruined by such frosts in early April. Dormant fig trees can be expected to withstand winter tempera-

tures of 15° Fahrenheit without injury, but usually suffer at temperatures lower than this.

In some districts killing fall frosts occur so infrequently as to cause the grower little concern; in others they are sufficiently prevalent to warrant some method of frost protection. Wrapping stems and leaves thoroughly with cornstalks or tules in October is a common practice with one or two-year-old trees, the stalks being removed in the spring when danger of frost is past. The use of orchard heaters is recommended in some districts to protect the mamme crop of caprifigs during the coldest nights of winter.

Fig. 6.—Frost injury in young fig orchards is usually irregular, some trees being killed to the ground while neighboring trees are uninjured.

The pruning of young frozen fig trees should be delayed until the extent of the injury is apparent. The tree may send out several vigorous suckers from the trunk or main branches, in which case the dead top should be cut back and the suckers thinned out to the desired number. Suckers which push out below the surface of the ground are often so loosely attached that they topple over of their own weight after making a few feet of growth. Some growers prefer a tree with a single trunk while others are willing to select from two to four well-spaced suckers from which to build a permanent head. The important thing in either case is to select suckers which are firmly attached to the main trunk.

Heat and Humidity.—Figs for preserving or canning are being produced in regions of summer showers and of a fairly high humidity. The production of dried figs is most satisfactorily accomplished in regions having long sunny days, maximum daily temperatures of around 100° Fahrenheit, and a relatively low humidity. At Riverside, for example,

Calimyrna figs ripen well, are of excellent quality, but are not readily dried on account of morning fogs. In the San Joaquin Valley summer fogs are practically unknown, but on the other hand temperatures considerably above 100° are of common occurrence. Past seasons, especially that of 1930, have shown that excessive heat ripens figs prematurely, toughens the skin or rind, and increases the proportion of figs deficient in pulp, commonly known as "floaters." Sunburned and excessively dried or leathery figs are more abundant in the southern part of the San Joaquin Valley district, while splitting and other fruit-spoilage diseases are more prevalent in the northern parts of the district. The vigor or health of fig trees can be influenced by cultural methods, especially by irrigation, so that they can withstand extremes of heat without serious injury to the quality of the maturing fruit.

Other Climatic Factors.—Wind is not an important factor in fig culture as far as the tree itself is concerned. Occasional strong winds may uproot mature trees with poor root systems, especially if the ground at the time is softened by rain or by irrigation water. Gentle breezes during the drying season are welcome since they favor the proper maturing of the fruit. Strong winds at the season of ripening whip the foliage and cause scarring of fruit, especially of such canning varieties as the Kadota, thus lowering the grade as well as the selling price of the fruit. Windy weather during the season of caprification may seriously interfere with the normal flight of blastophagas and result in a poor setting of figs of the Smyrna type.

Practically all commercial fig orchards in California are grown under irrigation and the rainfall factor is therefore not important except as it insures an adequate supply of irrigation water. Rains at the time of caprification are unwelcome and are especially serious during the drying season, when figs may be either completely ruined or considerably injured in commercial quality.

Fruit characters of the fig are materially affected by differences in climate. Second-crop Kadota figs produced near the coast in Los Angeles County have a distinct neck, green skin, and violet-tinted pulp, while those produced in the San Joaquin Valley have no neck or a very short indistinct one, a golden-yellow skin, and an amber pulp. Mission figs of the second crop grown along the coast are larger and more elongated but less sweet and rich than those grown in the hot interior valleys.

SOILS

Fig trees in California thrive on a wide range of soils. Light sandy soils have in various districts produced fine large fig trees bearing an excellent quality of fruit. Commonly, however, trees in sandy soil become unhealthy and unprofitable on account of root-knot caused by nematode worms, which are more prevalent in sandy than in clay soils. Excellent Adriatic orchards are found on a very heavy, sticky clay soil at Merced, with a hardpan about 28 inches beneath the surface. Some of the best Mission fig orchards are located on deep, rich, river-bottom soils having an abundant moisture content. Soils having a water table closer than 6 or 8 feet to the surface or a water table which fluctuates several feet up and down during the year, should be discounted for fig culture. Deep clay loam soils are the best for the culture of fig trees, but during the first few years vigorous tree growth may occur in such soils at the expense of fruitfulness.

The extent of the adaptation of hardpan lands to fig culture depends upon the thickness and nature of the hardpan and the depth of the surface soil. Some hardpan formations are so dense and thick that roots cannot penetrate and blasting simply produces potholes where tree roots do not thrive on account of poor drainage. Such soils should not be utilized unless there is a depth of at least 4 feet of good surface soil. Some gray hardpans soften under irrigation and tree roots penetrate readily. Hardpan of the Madera or San Joaquin series is not disintegrated by irrigation and must be blasted in order to get deep root penetration. Production of a uniform growth or condition of fig trees on the leveled hog-wallow type of hardpan land is difficult on account of the varying depth of the surface soil, but can be obtained by thoroughly blasting the hardpan and excavating the tree holes.

The statement is often made that an abundance of lime in the soil is indispensable to the production of a superior drying fig. While the soils of the Smyrna fig district are somewhat richer in lime content than soils of California fig districts, analyses made by this station in 1893 showed that in several of the typical California districts there is a high percentage of lime present. Experience since that time does not indicate any marked deficiency of lime in fig-orchard soils.

Alkali soils should be regarded as submarginal for figs, because the trees can be expected sooner or later to show tipburn of the leaves and reduction of foliage sufficient to allow sunburn of branches and serious loss of crop.

PROPAGATION

Fig trees are so readily propagated from woody cuttings that no other method of propagation is considered in a commercial way. The tree is vigorous and productive on its own roots and the use of another stock would be desirable only in case it were found to be resistant to troubles such as root-knot. Fertile fig seeds germinate readily and seedlings produce in three or four years either caprifigs or edible figs, very few of which show promising characters.

Suckers which appear around the base of older fig trees are satisfactory for orchard planting, especially if lateral roots have already developed at the base of the sucker. Fig orchards have in some cases been successfully established by planting fresh cuttings directly in the field in a permanent location, but most growers prefer to plant cuttings previously rooted in a nursery.

Cuttings.—Fig cuttings are made during the pruning season, preferably in January or February, the brush being worked up as rapidly as possible to prevent drying-out of the wood. Tip cuttings are inclined to start terminal growth quickly before a root system has become established. Any wood up to two or three years of age may be used for cuttings as long as it is not too succulent and pithy. Cuttings averaging about 8 inches in length with short joints and from ½ to ¾ inch in diameter are preferred by nurserymen. Cuts are made with a pair of sharp pruning shears just below a joint at the base and just above a joint at the tip, the cuttings then being tied with wire into bundles of fifty each. The bundles are placed butt end up in a well-drained trench or on the surface of the ground and covered several inches deep with a sandy soil, care being taken to prevent air pockets by sifting the sand thoroughly between the cuttings. The sand should be kept moist but not soaking wet and the cuttings examined occasionally to see that they are not rotting.

Planting in the nursery is done as soon as the ground can be prepared properly, which is generally about March 15. The cuttings are then planted full length a few inches apart in furrows prepared with a plow or a shallow subsoiler, the rows being spaced 4 feet apart. Planting should be followed immediately by an irrigation, and soil moisture should later be kept sufficient to maintain a steady growth of the young trees. Suckers and laterals are removed soon after they appear. Poor success in rooting cuttings may be due to the use of small or weak wood, to their drying out during preparation or planting, or to improper heeling-in of the bundles.

Fig cuttings can be taken from any tree or parts of the tree of the desired variety as long as healthy branches are used. Bud sports are so seldom found in fig trees as to be of negligible importance. Claims that superior strains or types of the Mission exist have not been substantiated, the superiority of the fruit being due to soil and climatic conditions rather than to a different strain of tree. Calimyrna orchards, however, should be examined while the fruit is on the trees in order to avoid later getting cuttings from stray trees of other varieties of the Smyrna type which are not commercially desirable.

ESTABLISHING THE ORCHARD

The successive steps in the establishment of a commercial fig orchard are: leveling the land, installing an irrigation system, locating or spacing the tree holes, preparation for planting, selection of nursery stock, planting, care of the young tree, intercropping.

Leveling the Land.—Proper preparation of orchard land before planting is of prime importance. In some cases sites selected for fig orchards are fairly uniform in slope and require little if any leveling. Generally, however, it is necessary to level the land to conform with the irrigation system and to facilitate the distribution of irrigation water. Hog-wallow land, which has been widely used in the San Joaquin Valley for fig culture, can be reduced to a fairly level surface although hardpan knolls with no top soil are usually still in evidence.

Installment of an Irrigation System.—Since irrigation is essential to the successful production of figs in most parts of the interior valleys, a good water supply of from 12 to 24 acre-inches per acre should be assured. The amount needed will vary with the rainfall, age and vigor of the tree, climatic conditions, growth of covercrop or weeds, etc. The quality of the water used for irrigation is often just as important a matter as the quantity. Analyses made of several samples of well water to be used for irrigation in one new fig district showed the total solids to be dangerously high. Prospective investors in fig lands should thoroughly investigate this as well as other matters connected with the water supply.

The irrigation system and pumping plant, if the orchard is not in a gravity water district, should be installed before planting, although trees can be kept in fairly good condition for the first year by watering from a tank wagon.

Spacing.—Fig trees are generally planted on the square system, the spacing depending upon the variety. For upright-growing trees such as the Calimyrna, a spacing of 30 feet is usually sufficient; but if the soil is deep and rich they will eventually crowd each other at 30 feet unless

they are kept in bounds by pruning. In some soils 30 feet may be sufficient space for Adriatic trees, which naturally have a spreading habit of growth, but in deep rich soils 32 to 36 or even 40 feet will provide none too much room when they come into full bearing. The problem of spacing the Mission is the most difficult of all since trees of this variety grow to immense size in deep soil. Mission trees planted 40 × 40 feet in some cases appear to be too close. In some orchards they are planted from 32 to 40 feet apart and the size of the mature tree is regulated by pruning. Some experienced growers advocate planting Mission trees from 20 to 25 feet apart and removing alternate trees later when they begin to crowd.

Kadota and Turkey trees, the fruit of which is generally harvested fresh, are commonly crowded together and the trees kept low by pruning in order to facilitate picking of the crop. On the square system the trees are usually spaced from 20 to 24 feet, although some large plantings have been made with the trees much closer. Some growers prefer to set the trees 10 to 12 feet apart in the row and the rows 16 to 18 feet apart, a system allowing cultivation and irrigation in one direction only. Heavy yields of second-crop Turkey figs are secured in southern California by setting the trees still closer, about 6 × 8 feet, and pruning the trees back practically to the ground each year.

Preparation for Planting.—Stakes for tree holes are set by means of a planting wire or chain, or sometimes by sighting across properly placed end stakes. Holes are dug by hand a short time before the planting. In old grain land where a cultivation sole or plowpan is present, an excellent procedure is to subsoil deeply both ways, the subsoiler being pulled along the tree rows and trees planted where the furrows intersect.

Lands having a distinct stratum of hardpan a short distance below the surface are prepared for planting by blasting for each tree hole in late summer when the ground is still dry enough to shatter or crack. The leveled land is first staked out and holes for blasting drilled by hand or by a power driller. After blasting, the holes are excavated by hand, the chunks of hardpan removed, and the hole filled with fresh soil which is settled by winter rains or by irrigation water. In the spring the land is restaked and tree holes dug as usual.

Selection of Nursery Stock.—Fig trees are generally dug from the nursery at the end of one season's growth by means of a special U-shaped cutter which runs beneath the tree row and severs the roots. The trees are then pulled, graded into three sizes of 2 to 3 feet, 3 to 4 feet, and 4 to 5 feet in height, and tied in bundles of ten trees each. These bundles are heeled in in trenches (fig. 7) of sandy soil until planting time. Trees left

in the nursery for a second season's growth should be cut back almost to the surface of the ground and a single shoot allowed to form the new top, since properly spaced dormant buds push out better from a one-year-old trunk after the tree is set in the orchard.

One-year-old trees have tender roots, which are easily mangled or broken loose from the base of the cutting unless they are carefully han-

Fig. 7.—Fig nursery stock graded into sizes and tied in bundles of ten, can be heeled in in trenches, provided there is good drainage of excess surface water.

dled in digging. Two-year-old trees have roots firmly united to the cutting and are less susceptible to injury in their transfer from nursery to orchard. There is little if any advantage, however, of one age of tree over the other as long as the root systems are equally good. There appears to be no advantage in planting large-sized fig trees rather than medium or even small trees with good root systems. An experimental planting of three distinct sizes of fig trees at Riverside has demonstrated that at the end of four seasons of growth the trees of all sizes are about equally vigorous and productive. The use of badly frosted nursery trees should be avoided. Healthy fig trees should show a copious exudation of white juice or latex when the bark is pricked with the point of a knife.

Planting and Care of the Young Tree.—Rooted trees may be planted at any time while dormant if the soil is sandy and well drained. If they are on heavy soil, it is better to delay planting until the middle of Feb-

ruary or even until March, as the young trees might be injured by standing water.

The method of planting a fig tree differs very little from that used for any other deciduous fruit tree. Especial care, however, should be taken to prevent exposure to the sun and drying-out of the roots during the various steps in the transfer of trees from the nursery to the orchard. Some growers advocate the puddling of roots in mud to insure freedom from injury; others keep the trees at planting time immersed in a barrel of water hauled on a sled. Excellent results, however, can be secured by heeling-in small lots of trees in convenient places near the orchard and by distributing to the planters only small numbers of trees at a time. Since the trees are on their own roots they may be advantageously planted from 2 to 4 inches deeper than they stood in the nursery row. At the time of planting, the roots should be trimmed and all mangled roots cut back to healthy wood. It is also important to examine carefully the bark of the rooted cutting and rub off any dormant twigs or branch buds which may have started. The removal of such buds at planting time will relieve the grower of considerable trouble and expense in removing suckers later on.

After planting, the trees should be headed back, the height depending upon the ultimate method of harvesting the crop. The ideal system is to head the trees high, 30 to 36 inches, and have main framework branches spaced through the upper 18 inches of top. Practically it is not often a simple matter to secure properly spaced branches on a high-headed tree, although such spacing may avoid bad crotches and the necessity of bolting or bracing in future years. Trees are usually headed at about 24 inches, but Kadota and Turkey are started somewhat lower.

The necessity for the irrigation of newly planted trees depends upon the season and the condition of the soil. In most cases it is necessary to follow up the planting with a small stream of irrigation water or with a tank wagon from which several gallons of water can be taken to settle the soil around the roots. Postponement of irrigation in expectation of rain is a dangerous practice and is very likely to result in a loss of trees. It is a wise precaution to whitewash the newly planted trees in order to avoid sunburn.

Intercrops.—The practice of interplanting fig orchards with peach, plum, or other fruits has sometimes been advocated by nurserymen but has seldom proved a profitable procedure. It is better to double-plant the same variety of fig than to interplant with other figs or other fruit trees. In Stanislaus County the intercropping of young orchards with beans has been found satisfactory. In other districts very few growers

have found intercrops which have been both satisfactory and profitable. Alfalfa is undesirable in young fig orchards because it attracts gophers. Cotton may prove profitable some seasons and certain vegetables such as tomatoes are occasionally grown. In any case intercropping should be discontinued after three or four seasons and the trees given all the available space.

ORCHARD MANAGEMENT

Reasons for Pruning.—The main reasons for pruning fig trees are: (1) to produce a mechanically strong, healthy tree, capable of producing heavy crops over a long period of years; (2) to facilitate, in some varieties, the harvesting of fresh figs; (3) to stimulate the production of vigorous shoots bearing second-crop figs over a long season; (4) to prevent decadence of bearing trees.

It is important to note the fundamental difference between the fruiting habit of the fig and that of most other deciduous fruits. The peach tree for example, bears one crop of fruit on wood of the previous season's growth. The fig tree normally bears two crops each year, the first crop appearing on wood of the previous season, and the second crop on new wood of the current season's growth. The fruiting habits of different varieties of figs differ to some extent, and pruning methods which apply to one variety cannot be successfully practiced on certain other varieties. For instance, the Mission tree is notably unproductive under a system of very heavy pruning or stubbing back of branches, while trees of the Turkey and Kadota usually produce bountifully under such a pruning treatment.

Pruning the Adriatic and Mission.—The Adriatic tree grows naturally into a low, spreading, round-topped tree (fig. 8). There is little justification for any pruning of young Adriatic trees except the removal of lower, spreading branches and a certain amount of thinning of the interior branches where they become too thick. In pruning bearing Adriatic trees the tendency is to remove drooping branches which are in the way of cultivation and to neglect the top of the tree almost entirely. The top branches keep bending down with the weight of fruit and leaves and eventually their upper sides become badly sunburned from long exposure to direct sunshine and heat. In such extreme cases the only salvation of the trees is to cut back and thin out heavily to stimulate new growth from the trunk or main branches. Annual or biennial pruning throughout the top of mature Adriatic trees should obviate the necessity of heavy stubbing back as the result of sunburned branches. The aim should be to promote the production of new vigorous wood and to prevent the accumulation of a dense growth of short weak twigs.

The Mission tree, like the Adriatic, branches freely (fig. 9) and produces an abundance of laterals, the only pruning required being a little thinning out and the removal of crossing or interfering branches. Proper

Fig. 8.—Typical Adriatic tree at left, Calimyrna at right, same age.

Fig. 9.—The Mission usually develops into a tall much-branched tree which requires little pruning except an occasional thinning-out and the removal of interfering branches.

selection and spacing of the framework branches is more important with the young Mission tree than with most other fig trees, because the main branches generally form an acute angle at their junction with the trunk and have a tendency to split (down) under the weight of leaves and

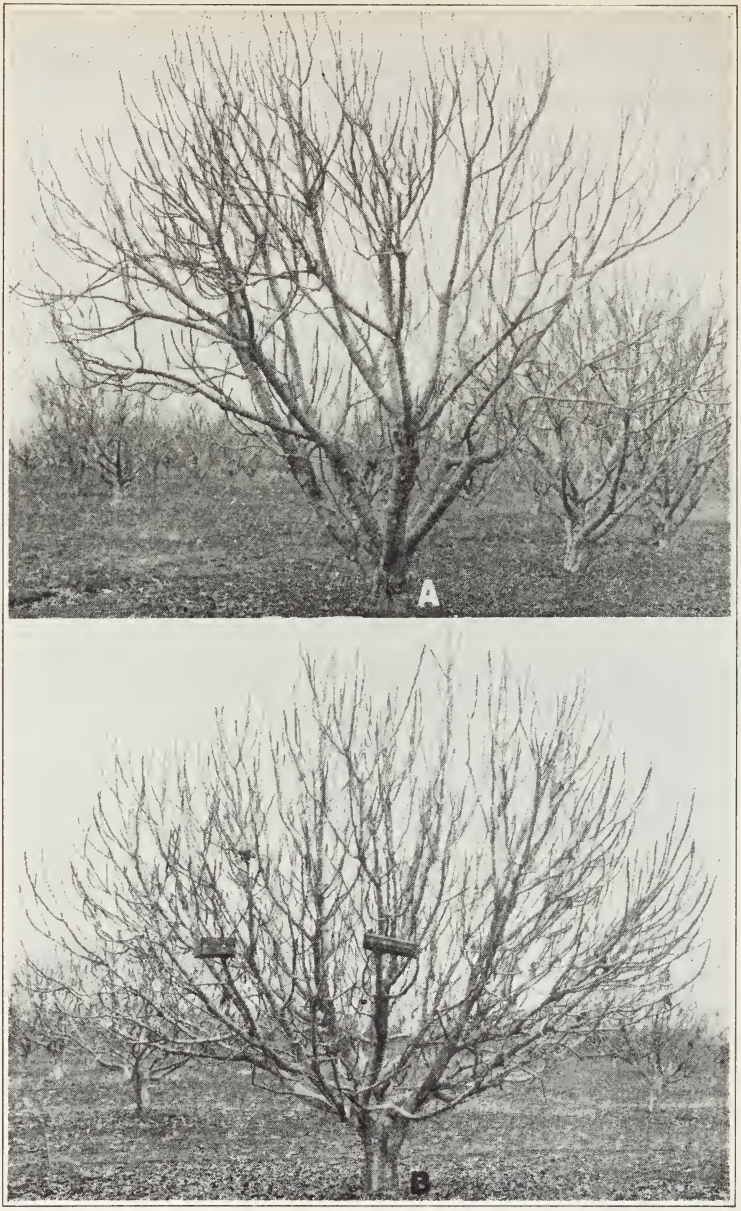

Fig. 10.—Two distinct types of Calimyrna tree: *A*, an open tree, each framework branch consisting of a leader with whorls of laterals at various intervals; *B*, a dense type of tree developed by heavy pruning or by stubbing back the upright branches each year for the first few seasons after planting.

fruit. Central wire bracing is sometimes practiced to prevent such damage to Mission trees.

Pruning the Calimyrna.—Calimyrna fig trees almost invariably produce long upright branches without laterals on current season's wood. The terminal bud continues the upright growth at the beginning of the next growing season while at the same time from two to four subterminal buds develop into laterals. The scaffold branches of the mature tree therefore each consist of a central leader with whorls of laterals at

Fig. 11.—A Calimyrna fig tree drooping under the weight of leaves and fruit; this can be overcome by proper pruning.

various intervals (fig. 10), the length of the interval depending upon the vigor of growth of the tree. Vigorous branches eventually are inclined to become top-heavy with the weight of fruit and leaves, to bend down, and to become sunburned and decadent (fig. 11). The pruning problem of the Calimyrna grower is therefore to produce trees and branches which are capable of standing upright under future heavy crops.

Some Calimyrna orchards on shallow soils have been brought into successful and heavy production without any pruning whatever, even the suckers being allowed to grow along with the main trunk. Most growers, however, prefer a standard tree with a single trunk from which all low suckers are removed. Moderately vigorous Calimyrna trees on shallow soils can be developed satisfactorily without any pruning except the removal of low-lying or interfering branches. Dormant buds on the upright branches usually push out into laterals in sufficient numbers to

thicken up the tree and to prevent the top-heavy condition mentioned above.

In deep rich soils young Calimyrna trees often produce upright branches several feet long without a single lateral. Either heavy winter pruning, or light summer pruning, may be used to shorten the intervals between laterals in such trees.

Winter pruning consists in cutting back the upright branches to stubs about 18 inches in length. This annual cutting back is continued each year until the tree begins to develop sufficient bearing surface to slow down the length growth to more moderate proportions. Thinning out must also be practiced else the top will be inclined to get too thick. Such heavy cutting back will eventually produce a symmetrical (fig. 10*B*), heavy-bearing tree, but the time of production is somewhat delayed.

The second method of producing laterals on young Calimyrnas is by pinching back or breaking off the tips of the vigorous branches in early summer. This results in checking the growth for a few days after which time from one to three laterals push out. These grow upright and are inclined to form an acute angle at the junction with the mother branch.

Some growers are enthusiastic about summer pruning, while others who have tried it have discontinued the practice in favor of the heavier winter pruning. Summer pruning has considerable merit if it is done systematically. The following points should be considered in using the system: (1) It should be used only on very vigorous trees which are inclined to make several feet of annual growth. (2) It should be done early enough in the season to insure a vigorous continuation of growth. (3) It should be followed up every two or three weeks by pruning back new vigorous branches which develop. (4) Experience seems to show that breaking off 3 or 4 inches of the tip produces a better system of branching than simply pinching out the terminal bud. (5) In case three laterals develop as a result of summer pruning, the removal of the center one in winter will result in better spacing of the two left.

The pruning of bearing Calimyrna trees consists of an occasional thinning out and heading back of the top in order to stimulate a constant succession of new vigorous wood on the main framework branches. Annual or biennial pruning of the top will help to prevent early decline of the tree and will encourage the production of fruit-bearing wood. Cutting out fairly large branches throughout the top is preferable to the stubbing back of small branches. The latter system encourages the growth of too many laterals and the resulting production of small fruit.

Pruning the Kadota.—The Kadota fig is grown primarily for the pro-

duction of fresh fruit and the trees are therefore trained low to facilitate economical harvesting of the crop. Under the standard system the young tree is headed at about 12 inches, and from three to five frame-

Fig. 12.—Kadota trees pruned heavily to develop a low-spreading system of branching. *A* and *B*, tree at end of second season, before and after pruning; *C* and *D*, same tree at end of third season.

work branches, preferably three, are allowed to develop at intervals on the trunk. All suckers are removed although three or even four main trunks may form the crown. Each winter the vigorous new branches are cut back heavily (fig. 12), leaving stubs about 12 inches long; they are also thinned out to admit light to the lower branches. The object is

to secure a low, nearly flat-topped tree (fig. 13) from which all the fruit can be obtained by pickers standing on the ground or on the main framework branches. In order to secure the flat top the inside branches are

Fig. 13.—Low-spreading Kadota trees are secured by pruning the outside branches long and the inside branches short. This shows a tree as pruned at the end of five growing seasons.

Fig. 14.—The exposed branches of spreading flat-topped Kadota trees should be whitewashed or otherwise protected from sunburn.

pruned shorter than the outside branches (fig. 14). The amount of wood left and the extent of the cutting depend upon the vigor of the tree. Vigorous trees are cut heavily to promote the development of a large bearing surface; weaker trees are cut less heavily, for they are not capable of such heavy production. On one side of the tree a narrow space

is kept open to make it easy for pickers and pruners to walk in to the center of the low-spreading tree.

In most districts, however, this heavy winter pruning materially reduces the total fruit production during the early life of the tree. Experimental plots show that Kadota trees given a minimum of pruning, the centers being lightly thinned out and the topmost branches suppressed, have in the first four seasons after planting produced over three times as much fruit as neighboring trees heavily pruned each winter. By a continued suppression of the top at the desired height and

Fig. 15.—Lightly pruned Kadota trees increase more rapidly in size of trunk and are much more productive during the first few years than are heavily pruned trees. *A*, Tree at end of second season; *B*, tree after five growing seasons.

a moderate thinning out of the lower branches such Kadota trees (fig. 15) can be maintained for several years and the fruit be harvested economically. At the beginning of any growing season the framework branches can be cut back to stubs and the heavy system of pruning be substituted.

Pruning the Turkey.—A system of terminal bud pruning has long been practiced in certain Old World fig districts and is being used in the Coachella Valley on Turkey trees. The practice consists simply in removing with a knife in February, the terminal bud of each fruiting branch, the result being the stimulation of a greater number of lateral fruit buds into early development. Some growers of the Turkey fig under desert conditions find it advantageous to prune the trees as soon as the first crop has been harvested, thus stimulating a new growth for the production of fruit later in the season when the market is not so well supplied with figs from other districts. Growers of the Turkey in coastal

districts, where brebas are not so much desired, practice heavy winter pruning, as this variety is remarkably productive under such treatment.

Fig. 16.—*A*, Border Adriatic trees cut back to stubs; *B*, same trees after nine seasons' growth.

Pruning Caprifig Trees.—The method of pruning caprifig trees depends somewhat upon the variety grown. In general the trees are headed fairly low so that the fruit may be picked economically. During the first

few years the trees are pruned in order to shape the tree properly and to provide bearing surface. As the mamme crop of mature caprifig trees is usually a valuable asset, heavy winter pruning is not generally practiced. If necessary, some thinning out of branches may be done in midsummer after the harvesting of the profichi crop. One weak point in the succession of crops, the break between the profichi and the mammoni crops, can in the case of some varieties be overcome by pinching back the tips of new shoots here and there over the tree, about the middle of May. This temporarily stops the terminal growth but stimulates development of lateral fruit buds which will be ready to receive blastophagas early in June. Mature fig trees may be pruned at any time after the leaves drop and the wood becomes dormant. There is no evidence to show that pruned trees are any more susceptible to frost damage or to drying out at the tips than unpruned trees of the same age and under the same growing conditions.

Rejuvenation of Decadent Trees.—Reference has already been made to the occasional necessity for rejuvenation of old trees weakened by sunburn or other causes. In a sound orchard-management program where annual or biennial pruning is practiced, such a drastic treatment should never be necessary. Orchard or border fig trees with sound trunks and healthy root systems can be renewed successfully, however, by cutting back the main framework branches to short stubs (fig. 16), thus stimulating a growth of vigorous suckers from which new framework branches can be selected. Many growers prefer to spread this renewal of top over a three or four-year period by stubbing back a few main branches each season, at the same time getting a crop from the branches left. In any system of heavy pruning or stubbing back it is essential that the trunk and scaffold branches be protected from sunburn by a heavy coat of whitewash and that large pruning wounds be treated with wax or asphalt emulsion.

Topworking.—Any variety of fig tree in healthy condition can be topworked to another more desirable variety. Young fig trees can be readily worked over by budding, either the common shield bud (fig. 17) or the patch bud being used. In branches from one to three years old the buds, cut large for the older limbs, can be readily inserted any time the bark is slipping freely. This means practically any time during the growing season from April until October.

Buds inserted early in the season can be forced out by cutting back the stock and a good growth from the bud secured the same year. Buds placed in September or October will remain dormant until spring and must risk damage from cold and wet weather.

The buds are cut from wood of the previous season's growth if spring budding is practiced, and from succulent wood of the present season if fall budding is done. Make as small a T-shaped cut as possible and let the bud push its own way down at the base. Wrap with ordinary three-ply cotton string and leave for about three weeks, when the strings can

Fig. 17.—Either shield buds, as here illustrated, or patch buds inserted in fig branches up to 3 or 4 inches in diameter are readily forced out and make a good union with the stock.

be cut. The stock must be partly cut back in order to force out the bud, and it is advisable to leave a safety branch or two to prevent too rapid growth from the buds. Patch buds are successfully used in branches several years old. Shield buds can readily be inserted at the base of suckers forced out by previously cutting the large branches severely.

Grafting, however, is the usual method for topworking fig trees. Two methods of grafting are commonly employed, namely, the cleft graft and the bark graft. Successful cleft grafting (fig. 18) has been done on thousands of young trees with branches up to 3 or 4 inches in diameter,

by the following method. After selecting the limb to be grafted, saw it off at the point desired. Next split the stub with a heavy knife or cleaver and insert a wedge of hardwood in the center of the cleft to hold it open. With a sharp thin-bladed pocket chisel cut a thin sliver from each side of the cleft, leaving the sides smooth. From two-year-old wood, cut a short scion with two or three buds. Whittle the scion wedge-shaped so

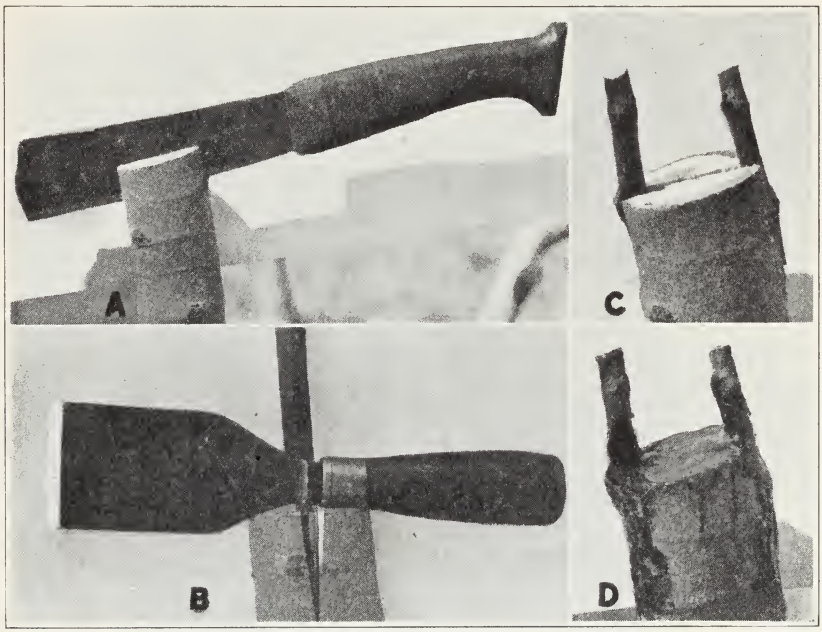

Fig. 18.—Tools and steps necessary in the process of cleft-grafting fig stubs not more than 4 inches in diameter: *A*, cleaver for splitting the stock; *B*, thin-bladed chisel for cutting a V-shaped notch, and, inserted in the cleft, a hardwood wedge for holding open the cleft; *C*, scions inserted into the clefts; *D*, freshly cut surface covered with grafting wax, the process completed.

that it fits tightly into the cleft, making the wedge slightly thicker on the outer side. With a small hammer drive the scion into place so that the inner or cambium layer of the scion is connected with the same layer of the stock. After the scions are set, one on each side of the limb, carefully withdraw the wedge and apply wax so that every part of the exposed wood and cleft is well coated. It is not necessary to tie string around the stub. One very material advantage of the cleft graft is that it can be done early in the season before the bark slips.

Bark grafting is very similar to budding except that a scion is used instead of a bud. The work is best done in late March or April, whenever the bark is found to slip freely. Large limbs are cut back to stubs and

the scions inserted around the edge, the number depending on the size of the stock.

The scions are cut with a sloping cut along the lower end in the same manner as for a whip graft. A U-shaped piece of bark the same width and length as the cut on the scion is removed from the edge of the stub. In some cases the flap of bark is left. The scion should then be inserted snugly into the opening so that the bark on each side of the scion touches the bark of the stock. Each scion is held firmly in place with a small nail or brad. After a sufficient number of scions are inserted in the stub they should also be tied firmly in place with strong cotton twine. All exposed surfaces are then covered thoroughly with grafting wax. The bark of the exposed stubs and trunk should be whitewashed to prevent sunburn. It is desirable that three or four scions grow on a large stub for a year or two until the end heals over, after which the scions can be thinned out to the desired number.

Good grafting wax can be purchased already prepared at hardware stores for a reasonable price or the operator can make his own wax according to several good formulas. In recent years a commercial preparation of a water-asphaltum emulsion has come into prominence and is rapidly displacing all others because it can be used cold.

Perforated paper sacks or newspapers should be tied loosely around the stub and scions in order to prevent drying out. Strings used in bark grafting should be cut or loosened whenever they show signs of cutting into the scion. Suckers which appear on the main trunk or stubs can be thinned out, although it is well to leave some of them to prevent excessive growth from the scions. Pinching back the growing scions occasionally may be necessary to prevent them from becoming top-heavy and breaking loose. It may even be found desirable to support the scions by means of strong laths nailed to the stock.

Irrigation.—In the fig districts of the Old World, where the rainfall is generally greater than in fig districts of California, orchard irrigation is the exception rather than the rule. Trees suffer, however, in dry seasons, and irrigation water would undoubtedly be an insurance against crop loss or injury. In California the irrigation of fig orchards is a necessary cultural operation except where the water table is high. The fact that individual trees or small groups of trees apparently thrive and bear some fruit on unirrigated hillsides or in neglected places does not necessarily indicate that larger plantings will produce good commercial crops under similar conditions. The unsuccessful attempts to produce satisfactory crops of figs on rolling, unirrigated land in certain

sections east of Fresno are examples of what may be expected under dry-land culture.

There is a common belief that the withholding of irrigation water from young fig trees tends to encourage deep rooting and that frequent light irrigations tend to encourage shallow rooting. Roots of trees, however, are naturally confined to the soil area wetted either by rainfall or by irrigation water; they do not grow into a dry soil. According to recent studies on orchard irrigation, plants like the fig which are "normally deep rooted cannot be made to keep their roots in the upper layers of soil if those at lower depths have a readily available supply of moisture and if no other adverse condition for root development is present below."[5]

An irrigation experiment on young fig trees at the Citrus Experiment Station, Riverside, shows after four growing seasons, during which the average annual rainfall was 12.28 inches, that trees receiving no irrigation water are slower in growth and less than one-third the size of those receiving frequent irrigations.

Weak growth of fig trees and the resulting lack of foliage may be due to frost, to injurious salts in the soil, to root troubles caused by nematodes or crown gall, to sunburn, etc., but is generally brought about by a deficiency in soil moisture. When young fig trees come into bearing, the tree itself is the best index of its water requirements. Excessive growth is unnecessary as it needlessly increases the size of the tree and probably increases the prevalence of fruit troubles such as splitting, souring, etc. Moderate growth means an increase of about 5 to 7 inches in length of terminal twigs each season for bearing Calimyrna, Mission, and Adriatic trees. Such varieties as the Kadota and the Turkey are encouraged by pruning and by irrigation to produce 2 or 3 feet of branch growth on which figs set and mature as long as weather conditions are favorable. The number of irrigations and the amount of water necessary to keep the soil above the wilting point and to prevent premature leaf drop cannot be told with certainty for any particular orchard and should be determined by the experience of the individual grower.

Methods of applying irrigation water to fig-orchard soils are not essentially different from those used in other deciduous orchards. These methods as well as means of conserving soil moisture are discussed in Extension Circular 50, to which reference has already been made. County farm advisors should be consulted as to local water sources,

[5] Veihmeyer, F. J., and A. H. Hendrickson. Essentials of irrigation and cultivation of orchards. California Agr. Ext. Cir. 50:1–24. 1930.

distribution of irrigation water on the soil in question, and the conservation of the available supply.

Cultivation.—The major purposes of cultivation are to facilitate the distribution of irrigation water, to incorporate organic matter with the soil, and to eliminate the competition of weeds for the available soil moisture. On rolling, uneven land it is a common practice to ridge up the ground into contour checks so as to prevent runoff or washing of soil in periods of heavy rainfall. Spring plowing or disking to turn under the covercrop, either natural or planted, and light cultivation as often as necessary to destroy weeds are the usual practices. Clean culture and a smoothing of the surface soil in drying-fig orchards are desirable so as to facilitate picking up the fallen fruit.

Maintenance of Soil Fertility.—The problem of maintaining soil fertility in a fig orchard is very similar to that in other deciduous fruit orchards. The fig tree, however, like the walnut, is deep rooted and the results of the application of commercial fertilizers to the surface soil will be very slowly apparent if at all. Three extensive field trials with different kinds and amounts of fertilizers on walnut trees in southern California have after seven years shown an increase of production only from nitrogen, and that insufficient to pay for the cost of the material applied. Two seasons' applications of fertilizers to bearing fig trees in various parts of the San Joaquin Valley failed to show any visible effects on tree or fruit. This does not mean, however, that no attempts should be made to maintain the natural fertility of the soil or to improve it.

Experiments with other fruit trees, especially citrus, in California, have shown that the application of potassium or phosphorus has no visible effects, that nitrogen (either in commercial fertilizers or in organic matter) is the only element that has decidedly improved tree growth or production. The fall application of some bulky organic material such as bean straw, alfalfa hay, or barnyard manure is advisable if it can be obtained at reasonable prices. Early spring application of some form of quickly available nitrogen such as nitrate of lime or sulfate of ammonia, or of organic nitrogen in such forms as dried blood, tankage, bone meal, etc., may be desirable to stimulate growth and yields.

There is a very general impression that the fig tree is a "lime-loving" plant and therefore the application of lime to the orchard soil will be decidedly beneficial. But most soils in California are well supplied with lime. The use of lime in citrus orchards has rarely shown any beneficial results. In a Modesto fig orchard, the application of amounts of lime varying from 3½ to 10½ tons, and of gypsum up to 3½ tons

to the acre resulted in no evident improvement either in soil condition or tree behavior.

Covercrops such as mustard, field peas, or bur clover, which start after the first rains and grow during the winter season, are best adapted to fig orchards. The continued ripening of the fig crop until October or later generally prevents the starting of early fall covercrops by the aid of irrigation.

The Practice of Caprification.—Caprifig trees are of value only in making it possible to produce edible Smyrna-type figs. It is preferable to plant them in sheltered places around buildings, or better still in isolated blocks on warm hillsides, where the winter crop will be less susceptible to frost damage, rather than in the main orchard. For every hundred Calimyrna fig trees three or four caprifig trees should be available. Trees of the two types should begin to bear appreciable crops at about the same age, five to seven years after planting. Individual caprifig trees often produce from 2,000 to 5,000 mamme figs and from 10,000 to 25,000 figs of the profichi crop. The following are standard varieties of caprifigs: Roeding No. 1 and Roeding No. 3 for early season; Stanford, and Samson (Markarian No. 1) for midseason; Milco and Roeding No. 4 for late-season caprification.

In small orchards the profichi from which blastophagas are ready to issue can be picked either at daybreak and distributed immediately, or picked in the late afternoon and distributed early the next morning. The blastophagas issue during the warm hours of the morning and not during the heat of the day. Temporary containers such as strawberry and fruit baskets, tin cans, paper bags, etc., can be used, or the figs can be strung on wire or raffia and hung on the branches. Most growers prefer more permanent containers made of galvanized wire netting.

Calimyrna figs are receptive to pollen when about ½ inch in diameter and remain receptive over a period of several days. It has been found in recent years that blastophagas carry into the fig not only pollen but the spores of injurious fruit diseases as well. The number of profichi distributed in Calimyrna trees should therefore be reduced to the minimum sufficient to insure a reasonable crop of edible fruit. On account of the various factors involved such as variety and conditions of caprifig used, weather conditions, etc., no definite rules can be laid down as to the amount and duration of caprification. It is generally better to obtain by caprification a light crop of clean figs than a heavy crop of figs inclined to rot on account of greater fungus infection.

Caprifig trees which fail for various reasons to carry successive crops can be colonized at certain seasons of the year. Some varieties, such as

Ficus palmata, produce a much more prolific crop of mammoni figs than others and a few trees or grafted branches of such varieties should be included in every collection. Ripe mammoni figs in the late summer or mamme figs in spring are used for colonizing trees and can, if necessary, be shipped considerable distances.

YIELDS

Fig trees are regarded as being of producing age the seventh season after planting, but under favorable conditions young trees may produce appreciable crops as early as the fourth season in the orchard. However, growers have frequently been disappointed in the delay of fig trees in coming into commercial or profitable production. This is especially true of Calimyrna orchards where for various reasons such as frost injury to trees, shortage of caprifigs, or a high percentage of cull fruit, the amount of merchantable dried figs may often be much smaller than was anticipated. Mission and Adriatic orchards produce heavier crops of dried figs than the Calimyrna and in addition the Mission usually bears a prolific crop of brebas for the fresh-fruit market.

Average production figures for any fruit crop are naturally low. The actual production of dried figs as shown by deliveries to the Association from typical orchards is as follows: Calimyrna, 1.18 tons per acre from 346.5 acres; Adriatic, 2.5 tons per acre from 113.6 acres of border and orchard trees; and Mission 2.5 tons per acre from 98 acres. Calimyrna orchards in full bearing are generally credited with producing from 1.5 to 2.0 tons of dried figs per acre and Mission or Adriatic orchards from 2.0 to 2.5 tons per acre.

Kadota fig trees are usually more precocious and heavier producers than are trees of other common-type varieties except the Turkey. Orchards three or four years of age may produce a few hundred pounds of fresh figs per acre while those from five to seven years of age produce from 1.0 to 2.5 tons per acre. Older orchards are producing up to 5 and even 7 tons of fresh figs per acre.

HANDLING THE FRUIT FOR THE FRESH-FRUIT MARKET

Varieties for Fresh-Fruit Shipping.—The California fresh-fig market is supplied with Turkey figs from the Coachella and Imperial valleys beginning about the first week in May, Mission figs starting to ripen a week or ten days later. Mission and Kadota brebas generally begin ripening in the San Joaquin Valley about the middle of June. Kadota, Mission, and Calimyrna figs of the second crop mature about August

first. Except for a short period in July between the first and second crops, fresh figs are therefore obtainable more or less continuously from May until November, or even later in some districts.

Picking.—Fresh-fig pickers usually wear cotton gloves as a protection against the acrid fig juice, carry a hooked stick to pull down branches, pick figs by twisting the neck loose at the stem end or cutting it cleanly with a knife or pair of clippers, and deposit the fruit carefully in shallow boxes which are then stacked temporarily in the shade. The proper color and stage of maturity of Calimyrna figs (the principal shipping variety) must be learned from experience as indicated by the local shipper and reports from the distributor in the consuming market. Figs too green carry well but are somewhat unpalatable. Figs too ripe are inclined to "leak" at the eye and develop spoilage diseases either en route or on the retail market.

Packing and Shipping.—For local markets figs are usually packed in one-layer rectangular flats containing about 6 pounds of figs and having crosswise paper or cardboard fillers between the rows. Small-sized Mission and Kadota figs are sometimes packed two layers deep without fillers. During June and again in August and September, however, local market competition is keen. L.c.l. (less than car lot) as well as full-express-car shipments to nearby states, and especially to large eastern cities such as New York, have therefore come to be of considerable importance to the California fig industry. Some small express shipments in returnable pony refrigerators are still made from certain districts. A carton-filler package, somewhat similar to the 6 or 12-egg carton, has been tried out but the extra expense does not appear to be justified for figs. The four-basket, square crate (fig. 19) with each fig in a translucent, tissue wrap, has a very attractive appearance and carries well in transit. Packing is usually done by the grower in a shed adjacent to the orchard and the packed boxes are assembled at a central plant for precooling.

Treatment of fresh figs with sulfur dioxide as practiced with grapes[6] has not been successful because the quantity necessary to arrest spoilage in figs is sufficient to injure seriously the color, texture, and flavor of the fruit. Fresh figs dipped in paraffin are improved in appearance and in shipping quality, but soon lose their attractiveness on fruit stands in hot weather. Moreover, even a very thin coating of paraffin or mineral oil on the surface of fresh figs somewhat impairs their edibility since such fruit is commonly eaten without peeling. Mission figs in a half-dried condition have for many seasons past been shipped successfully

[6] Jacob, H. E. The use of sulfur dioxide in shipping grapes. California Agr. Exp. Sta. Bul. 471:1–24. figs. 1–7. 1929.

Fig. 19.—In some districts fresh figs are packed one layer deep in a four-basket, square crate with each fig in a translucent, tissue wrap.

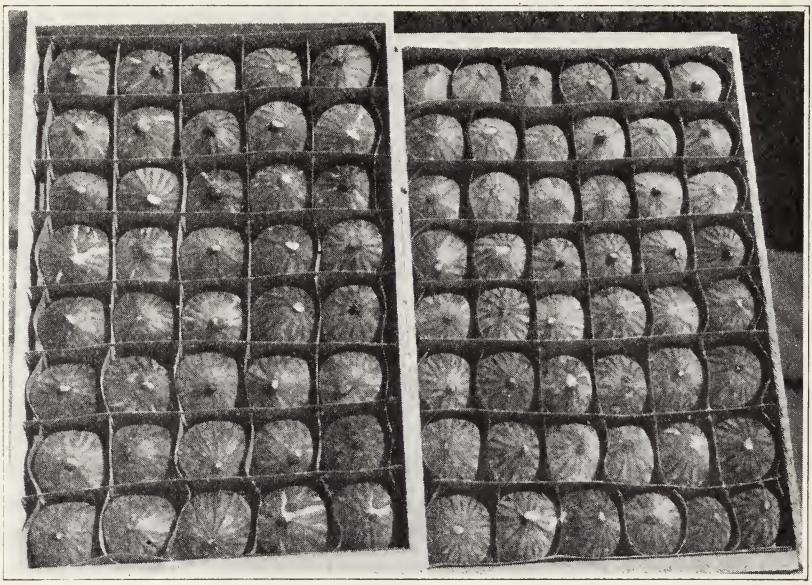

Fig. 20.—The egg-cell filler for packing fresh figs is convenient and economical, and makes an attractive package for retail markets.

to distant markets. The partly dried figs are picked from the tree, or from the ground as soon as they fall, and packed two layers deep, but are consigned in small lots and only to markets which are familiar with the product.

Fig Grades.—Fresh-fig shipments to distant markets are largely handled by the California Fruit Exchange, the Pacific Fruit Express, and other companies whose agents give instructions to growers and supervise the picking and packing. The Exchange, for example, gives the following specifications:

> Figs in order to grade Blue Anchor, must be mature but not overripe, free from excessive blemishes and defects and shall not be excessively sunburned, sour, split, or cracked. The fruit shall be well and tightly packed, and in the "egg filler" package [fig. 20] shall be uniform in size. Figs in this package shall conform to the following sizes and shall be so marked: 28, 35, 40, 48, and 54. It is recommended that no size smaller than 48 be packed. Fruit in the "filler" shall be packed with the stem end up. Figs packed in the 4-basket fig crate shall be reasonably uniform in size and meet the same quality specifications provided above.

HANDLING THE FIG CROP FOR PRESERVING AND CANNING

Suitable Varieties.—The preserving and canning of figs in California on a large scale started about fifteen years ago, both Calimyrna and Kadota figs being used. The Calimyrna canned fig is unsurpassed in flavor, richness, and eating quality but meets a sales resistance on account of its softness, seediness, and the large size of the fruit. The Kadota has therefore almost completely superseded the Calimyrna for canning purposes, being the only variety used by California canners with the exception of the Brunswick already referred to. The excellent canning qualities of the Kadota are due to the firm texture, yellow color, seedlessness, and small uniform sizes of fruit rather than to superior flavor.

Canners' Specifications.—Specifications of canners differ according to the ultimate product desired, whether for canned figs in a light syrup, for preserved figs in a rich, heavy syrup, or for glacéed or candied figs. Canners usually specify that delivered fruit of No. 1 grade shall be golden-yellow in color, free from overripe, underripe, sunburned, scarred, or caprified figs and not below certain minimum sizes. As the acreage and available tonnage of Kadota figs have increased, canners have become more particular as to the fruit to be processed, and growers have been forced to find other outlets for their crop.

Harvesting and Delivery of the Crop.—As with figs for fresh-fruit shipping, field agents of the handling concern more or less supervise the

picking and advise growers as to methods of delivery. Pickers should go over the trees often enough to get a large proportion of the fruit in the condition desired by the canner. The figs are picked into shallow buckets, picking boxes, or baskets suspended by a strap from the shoulders. The shallow lug boxes of fruit are delivered by growers to local canneries or shipped by truck or express overnight to more distant plants. Methods of processing figs vary somewhat in the different plants, the resulting products, as with other canned fruits, being sometimes very good but often poor and disappointing. Detailed directions for processing figs in various ways will, upon request, be furnished by the Division of Fruit Products, College of Agriculture, Berkeley.

Preserving by Freezing Storage.—Frozen foods of various kinds are now receiving considerable attention, and the possibilities of distributing fresh figs in the frozen state have not been overlooked. In 1930 the Georgia Agricultural Experiment Station reported[7] that peeled or unpeeled sliced figs frozen in a 35 per cent sugar syrup at a temperature of 0° Fahrenheit or higher proved to be a very satisfactory product. The Division of Pomology, University of California, started work on the freezing storage of fresh figs in 1921. More recent work done by the Division of Fruit Products showed that fresh frozen figs retain their natural color, flavor, and texture remarkably well, but do not find a ready market.

Recent investigations at Fresno by the United States Department of Agriculture in the freezing of four varieties of figs have shown that in all concentrations of syrup (20, 30, 40, and 50 per cent cane sugar) the Mission rated first, the Adriatic second, the Kadota third, and the Turkey fourth. For some unknown reason frozen Calimyrna figs develop an off-flavor of the skin which makes them unpalatable. Whole figs, unpeeled, gave a more attractive product than halved figs. The 20 per cent concentration of syrup gave an inferior, insipid product. Fresh whole figs in 30 to 40 per cent syrup, frozen and held at 12°, are excellent in appearance, firmness, and flavor.

HANDLING THE CROP FOR DRYING

Harvesting.—In Italy and other countries, fresh ripe figs are picked from the trees and dried in the sun, either whole or split in half. The best dried figs, such as those from the Smyrna district, are allowed to become partially dried on the tree (fig. 21) and to drop naturally to the ground, from which they are gathered and finished on trays or mats. The prac-

[7] Woodroof, J. G., and J. E. Bailey. Preserving fruits by freezing. II. Figs. Georgia Agr. Exp. Sta. Bul. **184.** 11 pages. 1930.

tice in California is similar to that in the Smyrna district since the labor cost of picking and drying fresh figs would, in this state, be almost prohibitive even if it were desirable. Cull Kadota figs from the canneries, however, are often dried into a marketable product. Figs left to become

Fig. 21.—Figs which reach full maturity, attain maximum sugar content, and become partially dry while still on the tree, make a dried product of the highest quality.

thoroughly mature on the tree attain a high sugar content and quality which can never be obtained by any drying of the firm ripe fruit.

Quality in dried figs begins in the orchard, both in the culture of the trees and in the handling of the crop. Trees suffering from lack of foliage due to insufficient soil moisture, from insect pests, or from root-knot-nematode attacks can hardly be expected to produce drying figs of prime quality. Figs which drop naturally or are dislodged by a light shaking of the trees should be picked up as frequently as possible, although in California growers find it impracticable, on account of labor costs, to pick up figs every day or twice a day as do some growers in the

Old World. Figs left long on the ground are unduly exposed to dust and dirt, to insect infestation, and to the bad effects of overdrying. All figs on the ground, regardless of quality, are picked up and dumped into lug boxes holding about 40 pounds, payment being by piece work.

Drying.—Sun-drying[8] of figs has been practiced for centuries in the Old World and is still the method almost universally practiced in all countries. The problem of artificial dehydration of figs differs from that of most other fruits since the figs which drop from the tree are already about three-fourths dried. The drying may be completed more cheaply and about as satisfactorily in the sun as in a dehydrator, although the latter is an insurance against damage in wet weather. Experiments at this station, however, have indicated "that the injury due to insect infestation and mold infection of Calimyrna figs could be reduced by sulfuring and by dehydrating. It is believed that picking and dehydrating would be profitable only if the price of figs was high and the infestation and infection so frequent as to render the figs otherwise nearly or quite unsalable."[9]

Treatment of figs in the dry-yard varies somewhat according to the variety. In the Winters district fallen Mission figs are placed directly into sacks, which when one-third to one-half full are tied at the open end and flattened out on ground exposed to the sun. The sacks are turned every two or three days until the figs are uniformly dried. Good results are secured in dry weather, but the figs may mold in damp weather; they may also accumulate dirt and lint from the sack. In most districts Mission figs require very little extra drying after they are picked up and can be finished in shallow boxes or on trays placed at first in the sun then stacked to allow free movement of air over the fruit.

In some arid districts Calimyrna and Adriatic figs are so nearly dried when gathered that they can be loosely boxed immediately or finished on stacked trays; but those of the best quality are obtained by picking up frequently, drying on trays in the sun (fig. 22) with occasional stirring or turning, and finishing on stacked trays. Kadota figs are handled like the Adriatic and are often classed with that variety in the market. The interior of a properly dried fig should have the consistency of a thick fruit jam or butter and the skin a "kid-glove" softness and pliability. Sweat boxes about 38½ x 26¾ x 7¾ inches are used for storing and equalizing the moisture in the fruit as well as for containers in which to deliver to the packing-house. The drying ratio of figs as normally har-

[8] See: Nichols, P. F. Methods of sun-drying fruits. California Ext. Cir. **75**:1–37. 1933.

[9] California Agr. Exp. Sta. Ann. Report, **1929–30**:104. 1931.

vested for drying is about 1½ to 1. When picked at the firm-ripe stage as for fresh shipment or for canning the drying ratio is about 3 to 1.

Sulfuring.—Only two varieties of figs are commonly sulfured. The Mission, being black, could not be improved in color by any amount of sulfuring; the Calimyrna, when properly handled, naturally becomes a light straw-yellow color. Sulfuring has in the past been commonly

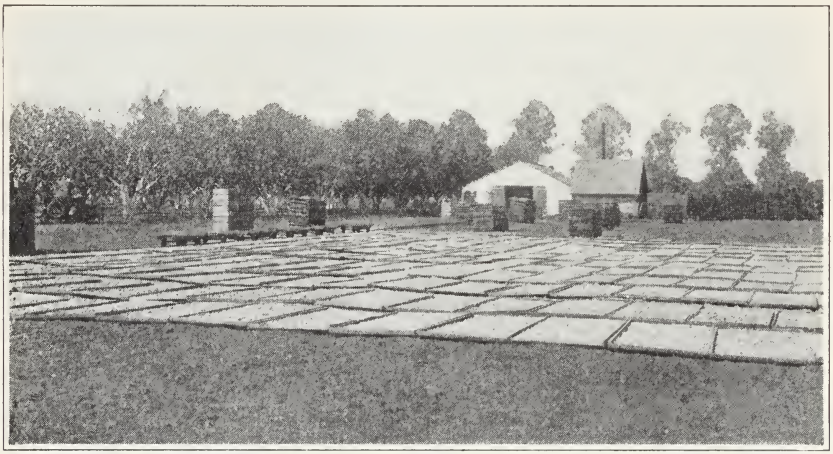

Fig. 22.—Figs drying on trays in the sun.

practiced with Adriatic and Kadota figs in order to prevent darkening, to facilitate drying, and to arrest incipient fermentation. The use of too much sulfur leaves an unnecessarily large amount of sulfurous acid in the fruit with a consequent disagreeable taste. In some states and in a few foreign countries there are regulations either restricting the amount of sulfur in dried fruits or forbidding the sale of sulfured fruits. Certain large buyers of fig paste specify in their contracts that a product containing appreciable quantities of sulfur is not acceptable. The practice of sulfuring should therefore to some extent depend upon the specifications of the buyer and not altogether upon the established customs of fig producers.

Growers who desire to sulfur figs may use the following method: Dip the figs in fresh water to cleanse and to moisten the skin so as to facilitate the action of sulfur fumes. Cold brine containing 5 to 20 pounds of salt in 100 gallons of water is commonly used for dipping but is an unnecessary expense. The fruit should be placed in the sulfur house while still moist and left until it acquires the uniform light-yellow color desired. Three pounds of sulfur per ton of figs with an exposure of 4 hours should be sufficient in tight sulfur houses.

Sorting and Grading.—On account of its peculiar structure and the common prevalence of internal spoilage organisms, the fig presents a sorting problem found in no other dried fruit. The Federal Food and Drugs Act states "that for the purposes of this act an article shall be deemed to be adulterated .... in the case of food .... if it consists in whole or in part of a filthy, decomposed, or putrid animal or vegetable substance." The pure food tolerance on dried figs was originally 33⅓ per cent; that is, if not more than one-third of the fruit showed evidence of insect infestation, fungus infection, or dirt, neither domestic nor imported figs in interstate commerce were held up for sorting. The tolerance was changed to 20 per cent about 1923 and since July 1, 1927, it has been 10 per cent. Payments to growers are made on a sliding scale based on the percentage of good figs delivered. Thus a delivery showing 100 per cent of merchantable Calimyrna figs at a 4½ cent advance would bring the grower $90 a ton, while one showing only 80 per cent good figs would return him only $72 a ton. Growers therefore usually sort dried figs carefully before delivery to the packer.

During the past few years delivered dried figs have been considered as consisting of three qualities designated as follows: Grade-A, Grade-C, and Stock Feed. Grade-A dried figs must be whole, clean (except for dust or loose sand), properly cured, of full sugar content, free from fungus diseases, and undamaged by insects. Grade-C figs may have certain defects such as clean bird pecks or splits, slight sunburn, etc., which detract from appearance rather than from wholesomeness. All figs unsuitable for human consumption are classified as Stock Feed. Unless the grower is equipped with storage facilities by which he can effectively prevent insect infestation he should deliver dried figs to the packing-house as soon as possible after they are properly dried.

Packers, after receiving figs from the grower, run the fruit over a shaker screen to remove foreign matter, then over large grader screens perforated with different-sized holes. This separates the figs into five commercial grades, namely: Standard, Choice, Extra Choice, Fancy, and Extra Fancy. Mission figs must be over $1\frac{3}{16}$ inches in diameter, Adriatic over $1\frac{5}{16}$ inches, and Calimyrna over $1\frac{3}{8}$ inches in diameter to qualify as Extra Fancy.

The individual test grader record representing 1,000 tons of Adriatic figs of the 1932 crop is as follows: the average weight of 100 figs was 1.81 pounds; 8.9 per cent were Standard, 16.2 per cent Choice, 28.8 per cent Extra Choice, 25.5 per cent Fancy, and 20.6 per cent Extra Fancy. The record of 430 tons of 1932-crop Calimyrna figs is as follows: the average weight of 100 figs was 3.14 pounds; 0.8 per cent were Standard.

3.4 per cent Choice, 15.5 per cent Extra Choice, 50.1 per cent Fancy, and 30.2 per cent Extra Fancy.

Packing.—The packing of dried figs is a specialized process generally performed by experienced workers in plants equipped for the purpose. Fancy and Extra Fancy figs are often packed whole as pulled figs, or split open and flattened out as layer figs, or packed in various other special styles. Standard and Choice grades are sold in bulk direct to the trade or ground up into paste.

The processing of dried figs is a fairly simple process and can be performed by the grower or housewife by the use of ordinary kitchen utensils. Experience shows that immersion of figs in boiling water from 1 to 3 minutes gives excellent cleansing, rapid gain in weight, and a uniform softening of the skin. The addition of salt (4 ounces per gallon of water) gives a slight flavor attractive to most palates. Figs with a moisture content exceeding 25 per cent will eventually mold if packed in moisture-proof containers.

Cardboard cartons with tight, glued ends, preferably wrapped in waxed paper or cellophane, are satisfactory containers for dried figs. Friction-top cans, lacquered inside, or glass jars, provide excellent receptacles if the figs are not overprocessed before packing. Vacuum-packing in glass or tin preserves figs in perfect condition indefinitely and might be employed for high-class trade.

PESTS AND DISEASES AFFECTING THE TREE

Fig trees are commonly regarded as being singularly free from serious pests, a belief based upon the vigor of individual and orchard trees growing under favorable conditions. The grower is, however, often called upon to combat pests which if uncontrolled may either kill the tree or greatly limit its productivity.

Gophers.—Fig roots are very susceptible to the attacks of gophers, and such rodents should be controlled by trapping, poisoning, or drowning.

Root-Knot Nematode.—Another serious root pest is the root-knot or garden nematode, a minute worm which penetrates the fig tree's fibrous roots and causes a bead-like swelling (fig. 23) or knot to develop. Injured roots rot off, whereupon the plant produces new rootlets to replace those that succumb. This is a drain upon the vitality of the tree, the seriousness of which depends upon the extent of the nematode infestation. Apparently many infested trees can thrive and produce fair crops if the orchard soil is maintained in a reasonable state of fertility. No effective

remedy is known when trees once become infested. Attempts are being made to find or develop rootstocks resistant to nematode attacks. Especial care should be taken to reject for planting any nursery trees which show root-knot.

Mediterranean Fig Scale.—A species of scale insect, the Mediterranean fig scale, has during the past thirty years become widely distributed in Fresno and Tulare counties. The scale is of the oyster-shell type and

Fig. 23.—Root-knot is caused by the attacks of minute nematode worms on the fibrous roots.

its presence is very easily recognized—on the leaves by a yellowish discolored area under each scale, and on the maturing fruit by vivid-green spots which contrast conspicuously with the normal yellow color of the fig. Such figs are unmarketable for canning and fresh-fruit shipping. The materials which give greatest promise of controlling this scale are oil emulsions and combinations of lime-sulfur and oil used as dormant sprays.[10]

Fig Rust Mite.—The fig rust mite is invisible to the unaided eye but its presence can usually be detected by the rusty color of the bracts within the opening or ostiolum of the fig. The mites are often found also in immense numbers on the bud scales and very young leaves of terminal twigs, sometimes causing leaf drop. It is seldom injurious in a commer-

[10] For an account of scale and other fig insects see: Simmons, P., W. D. Reed, and E. A. McGregor. Fig insects in California. U. S. Dept. Agr. Cir. 157:1–71. 38 figs. 1931.

cial way but when necessary can probably be controlled with an oil emulsion spray applied in early spring as the terminal buds open.

Pacific Red Spider.—The Pacific red spider is a serious pest, especially of the Kadota fig tree. It injures the foliage and spots the fruit. Healthy, vigorous trees are less susceptible to injury by red spider than trees whose vitality is reduced, usually by lack of sufficient soil moisture. Successful control depends considerably upon the ability of the grower to keep ahead of the pest. At the first indication of infestation, treatments should be applied. Neutral oil emulsions, of which various brands are on the market, destroy the eggs as well as active individuals, and commercial dry lime-sulfur is also effective.

Lichens.—Lichens, commonly known as moss, often grow freely on the trunk and larger branches of fig and other fruit trees. These are not parasitic, for they live on the dead outer bark; they may, however, harbor insects or fruit-decay organisms. When it is deemed necessary to destroy lichens, a spray of bordeaux mixture or of strong lime-sulfur will prove effective.

Sunburn.—The trunks of young fig trees and the bark of older trees suddenly exposed to direct sunshine by heavy pruning are very susceptible to injury by sunburn. Such injury is especially likely to occur in winter when the trees are leafless and the sun's rays strike the bark more directly than in summer. Whitewashing exposed parts will guard against sunburn injury. Some growers whitewash the trunks of fig trees early every season, a practice which has little value except for possible ornamentation.

Die-back.—Die-back of fig branches is a rather common occurrence and is generally due to either one of two fungi, a *Botrytis* or a *Sclerotinia.* In young trees, infection often takes place in the early winter when late green figs become frosted and start to decay; the fungus travels through the fruit stalk to the bark, killing it and girdling the branch. Such injury is usually not serious, since the die-back simply has the effect of a more or less severe pruning. Occasionally a large branch or even the trunk becomes infected and then the damage is more serious. Fresh figs which decay on the tree during the ripening season often start twig infection, which may result in a killing of the accompanying leaf and bud, a form of die-back known as "eye canker." Control measures are seldom necessary or practicable for die-back of fig trees.

Mosaic.—The foliage of fig trees in California frequently shows light yellowish patches (fig. 24) which contrast strongly with the normal green of the leaves. This appears to be a distinct mosaic disease transmitted by cuttings and is found more or less commonly on trees of prac-

tically all varieties in all sections of the state, the Mission being especially susceptible. It also causes malformations or dwarfing of leaves, premature leaf drop, and even shedding of immature fruit. It has never

Fig. 24.—Leaves of fig trees often show light patches which contrast with the normal green of the foliage. This appears to be a distinct mosaic disease.

been regarded as having commercial significance, but probably could not be controlled if it were desirable to do so. Certain types of figs are known to be resistant or immune to mosaic and these are being used in crosses with the hope of securing good seedlings free from mosaic.

PESTS AND DISEASES AFFECTING THE FRUIT[11]

Injury by Birds.—It is a well-known fact that fresh figs of both crops are especially susceptible to injury by birds, the California house finch or linnet being mainly responsible. Estimates placing the loss in commercial orchards above 10 per cent are not uncommon. The control of fruit-eating birds is an important matter but should be considered only

Fig. 25.—Splitting is one of the serious faults of the Calimyrna fig, and one which is probably uncontrollable, since it appears to be due to climatic factors.

after consultation with the County Agricultural Commissioner so as to safeguard innocent and beneficial birds of various species.

Splitting.—Splitting of immature fresh figs is a serious fault of certain varieties such as the Calimyrna (fig. 25). It appears to be governed by atmospheric humidity or sudden changes in humidity rather than by soil moisture, as was formerly thought. Splitting is ruinous to figs as the pulp is exposed to the attacks of insects, or even if uninfested the fruit dries into a low-grade product. Since it is practically impossible to control atmospheric humidity or changes in climate, the line of attack that

[11] See: Smith, Ralph E., and H. N. Hansen. Fruit spoilage diseases of figs. California Agr. Exp. Sta. Bul. 506:1–84. 47 figs. 1931.

suggests itself for the future is to find or develop varieties of figs which, like the Mission and the Kadota, are resistant to splitting.

Souring.—The term "souring" is one generally used to designate fresh-fig spoilage accompanied by a sour odor or taste of the pulp or by a dripping (fig. 26) from the eye. This is the cause of an immense loss of

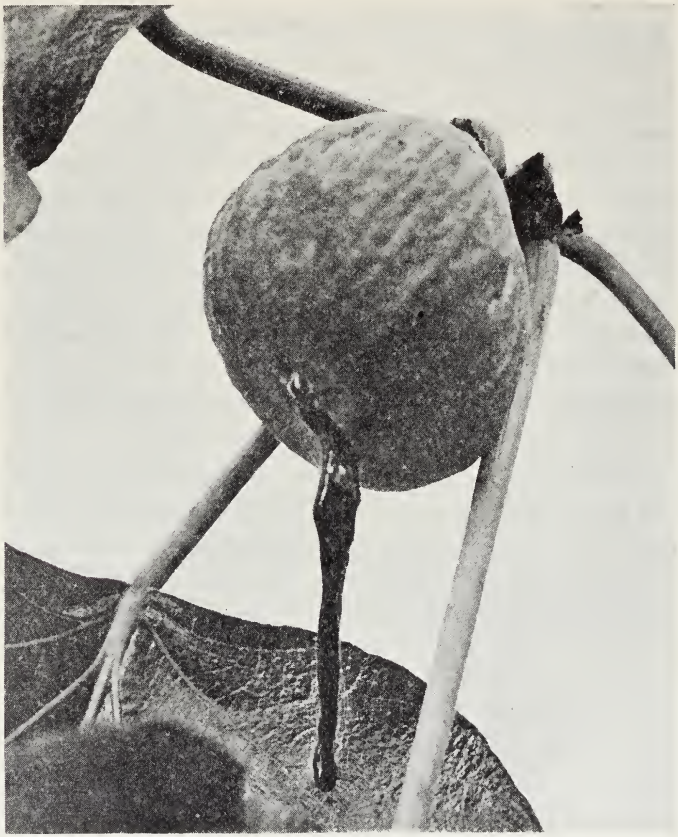

Fig. 26.—Sour Adriatic figs often drip and lose their fermenting juices through the eye. (From Bul. 506.)

figs every year, especially in the Adriatic and Calimyrna varieties. Souring is due to fermentation of the internal saccharine juices caused by specific yeasts and bacteria. Investigation has shown that figs are internally sterile until they are entered by insects, after which they commonly become infected with yeasts, molds, and bacteria. At the time of the opening of the eye and the softening of the fig, dried fruit beetles and vinegar flies contaminated with microorganisms gain entrance. While it may be possible that figs become unavoidably infected with airborne microorganisms, the general conclusion is that infection is lim-

ited almost entirely to insect transmission. The control of souring therefore appears to depend largely upon sanitary measures to eradicate the breeding material of the dried fruit beetle.

Larvae and adults of the dried fruit beetle are abundant in most fig orchards, especially those of the Adriatic variety, throughout the fruit-ripening season from about the middle of June to the first of November. "Stick-tight" figs which remain on the trees all winter harbor some beetles, but the adults mostly overwinter in other places where there are accumulations of decaying fruits, cull figs, or raisins, or in dried-fruit warehouses. They also overwinter in the soil in the pupal stage. The duration of the life cycle depends chiefly upon temperature, but since in warm summer weather successive generations of beetles develop about every three weeks, the number of beetles increases prodigiously in a very few weeks. The problem of control has not been solved. Trapping of the adults can be carried on, but the efficiency of traps now used is not high enough to result in control. Sanitation or the elimination of breeding places of the beetles is strongly recommended.

The Mission and Kadota figs are not affected by souring to any serious extent.

Mold.—One of the most troublesome defects in dried Adriatic and Calimyrna figs is that which in the trade is called "smut and mold" or simply mold. This is a condition in which the inside of the fig is more or less filled with a discolored mass of moldy tissue which not only ruins the fruit commercially but is still more objectionable on account of the impossibility of detecting all the moldy figs without splitting them open. These fungi enter the figs while they are still on the tree, and not on the ground or drying trays. There is a good deal of evidence that very small insects, particularly thrips and certain species of mites, carry in the mold spores at an early stage when the figs are still green and before the eyes have opened. If this is true it is possible that the destruction of these insects before they enter the figs would prevent smut and mold. To accomplish this it has been suggested that fig trees be sprayed with oil sprays at one or more times before the second-crop figs reach much size. No actual results of this sort, however, have as yet been obtained.

Smut.—Smut is one form of mold in which the fungus forms a black, dusty mass inside the ripe or dried fig. No positive method of prevention is known, but spraying for the control of thrips and mites may be of benefit.

The Mission and Kadota varieties of figs are almost immune to smut and mold.

Endosepsis.—Endosepsis or internal rot is caused by a fungus occur-

ring in caprifigs and carried by the blastophaga into the edible figs. The causal organism lives at first on the dead stigmas of the caprifig flowers but eventually fills the interior with a white mold. The symptoms of the disease in edible figs are not always visible externally as it progresses from the cavity of the fig outwards. Sometimes the fungus affects only the pulp, producing a bright red rot which in the dried form has a characteristic, disagreeable odor and taste. When the skin is affected, endosepsis shows as a water-soaking of the surface accompanied by a pinkish or purplish pigment, especially around the eye.

The control of endosepsis is discussed in detail in California Agricultural Experiment Station Bulletin 506. Briefly, the method is as follows: remove all mamme figs from the trees in March, just before any blastophagas have issued; sort out and destroy all frozen, bruised, or defective figs; store in a cool place until time for using, that is, until profichi are ready for colonization; cut and split the mature figs into halves, submerge in a solution of Semesan, 1 ounce to 4 gallons of water, for 15 minutes; dry figs as quickly as possible and place in containers in the caprifig trees; remove the mamme figs at the end of four days and destroy them or treat them again with the Semesan solution and place them a second time in the trees. Evidence at present indicates that the removal and treatment of mamme figs every year is necessary to ensure control of endosepsis.

Endosepsis affects all varieties of figs but only when they have been caprified. Consequently the disease may be entirely prevented in Adriatics, Missions, and Kadotas by removing all caprifig trees from their vicinity.

Dried-Fruit Pests.—Insect infestation of drying and of dried figs has until recent years been accepted as a matter of course both in Old and New World fig districts. With the passing of stringent pure-food regulations already referred to, the study of dried-fruit insects and methods for their control has become of extreme importance. The principal insects which infest dried figs are: the dried-fruit beetle (described above), the Indian meal moth, the fig moth, and various grain beetles. Infestation commonly occurs in the orchard during the period the figs are drying on the tree, lying on the ground, or are spread out on trays, as well as in the storehouse.

As a result of recent work done by the Bureau of Entomology of the United States Department of Agriculture, at Fresno and vicinity, the Dried Fruit Association of California issued the following recommendations to fig growers: Pick up and dispose of the first crop of figs, which provide a welcome host to dried-fig insects; gather second-crop figs as promptly as possible, at least once a week; dry figs under covers

of tobacco shade cloth; cover all figs in stacks of trays and in boxes with shade cloth supported so that the cloth will not be in contact with the fruit; deliver figs to buyer as promptly as possible or protect them immediately after drying by fumigation and insect-tight storehouses.

For fumigation of storehouses on ranches, carbon disulfide at the rate of 15 or 20 pounds per 1,000 cubic feet can be used satisfactorily in warm weather, although it is inflammable and at times explosive. If a fairly tight sulfur house is available, the burning of sulfur, 15 pounds per 1,000 cubic feet, can be recommended. Chlorpicrin is being used successfully, especially in the Merced district, and appears to be a good fumigant where its irritating fumes will not be a disadvantage. Hydrocyanic acid gas is an effective fumigant but must be used with extreme caution as the gas is fatal to human beings. Ethylene oxide is used to some extent on ranches, and is most effective in very tight enclosures which can be heated in cool weather.

UTILIZATION AND FOOD VALUE OF THE FIG

Figs are consumed fresh, dried, and canned, as well as in various prepared forms. Fresh figs are widely used in fig-growing districts, and with the improvement of transportation facilities are becoming increasingly important in local and distant markets. Unfortunately the perishable nature of the fruit makes it almost impossible to handle fresh figs on the retail market as cheaply as most other fresh fruits. The same thing applies to the canned and preserved product; for fresh figs can hardly be harvested and handled at the cannery as economically as peaches or pears for instance.

Dealers report that figs preserved in light syrup are too sweet to suit some tastes, but that the same people might relish an acid or tart fruit packed in a much heavier syrup.[12] Canned figs of various brands differ considerably in quality, and the product needs standardization. Strange as it may seem, fresh fig jam, which almost every grower regards as a delicious product, is reported by canners and dealers to be a drug on the market, hence it is not put out in any large quantity.

The bulk of the fig crop is consumed in the dried form. Fancy packs for the holiday trade provide an outlet for some of the better grades of dried figs, especially of the Calimyrna variety; actually, however, a relatively small percentage of the total California dried fig crop enters into fancy packages. The baking trade takes the larger portion of the crop for the preparation of fig newtons, fig bars, etc. Dried figs are either ground up locally into fig paste for bakery use, the Calimyrna, Adri-

[12] See: Spangler, R. L. Market demand for canned figs. U. S. Dept. Agr. Bur. Agr. Econ. 14 pp. July, 1930. (Mimeo.)

atic, and Kadota being used separately or blended together in the desired amounts, or the figs are shipped in bulk to baking concerns in various parts of the United States. Retail stores generally handle dried figs along with other dried fruits for household use.

Analyses.—Numerous analyses of fresh and dried figs have been reported. The sugar content of California fresh figs averages 15.5 per cent, although some show as high as 20.0 per cent sugar. Analyses of dried Smyrna-type figs grown at Fresno, of imported Smyrna figs, and of the seeds of the Black Bulletin Smyrna fig were made over thirty years ago.

TABLE 1

AVERAGE ANALYSES OF DRIED FIGS*

Variety	Number of samples	Per cent of water	Per cent reducing sugar	Per cent fibre
Calimyrna	19	15.7	62.8	5.8
Adriatic	21	16.8	64.3	6.9
Mission	8	16.3	64.2	4.5

* Unpublished analyses made in connection with a dried fig contest held at the time of the 1922 Fig Institute in Fresno.

Calculated at the same water content, 21.06 per cent, the California figs show 63.92 and the imported figs 62.50 per cent total sugars. The seeds show 6.0 per cent water, 14.0 protein, 13.5 carbohydrates, 34.4 fat, 30.4 fiber, and 1.7 per cent ash.

Analyses made in connection with a dried-fig contest held at the time of the 1922 Fig Institute in Fresno are given in table 1.

Analyses of Kadota figs show that the total sugar in the fresh fruit varies from 19.0 to 28.0 per cent and in the dried fruit from 68.0 to 75.0 per cent. Analyses of Adriatic figs at different stages of maturity show that while the fruit is still green and firm but the eye fairly well opened, the percentage of moisture is 83.2 and the percentage of sugar 9.1, that when the fig is shriveling, with the pulp still red, there is 52.4 per cent water and 46.3 per cent sugar, while at the stage of completed normal drying in the orchard the figs have 29.0 per cent water and 56.8 per cent sugar.

Food Value.[13]—Figs possess in an unusual degree two important food qualities, a definite laxative effect and a remarkably high excess alka-

[13] Morgan, Agnes Fay. The unusual nutritive value of figs. Pacific Rural Press 123(1):6. Jan. 2, 1932.

Morgan, Agnes Fay, Anna Field, and P. F. Nichols. Recent studies of the vitamin A and C content of dried apricots and figs. The Fruit Prod. Journal 11:304. June, 1932.

Jaffa, M. E. Food value of figs. Proceedings of the 13th Annual Institute of Fig Growers of the State of California, Merced. p. 42–47. Oct. 25, 26, 1929.

linity of ash. The laxative effect is probably due to the bulk of seeds and fiber combined with some specific solvent present in the juice of the fruit. The medicinal preparations known as "syrup of figs" owe their laxative properties in large part to senna or to other drugs rather than to their fig content.

The chief nutritive element in dried fruits generally is sugar, one of the most valuable of the carbohydrates and certainly the most easily digested and assimilated of all. The real value of food to the body depends on the ingredients more than on the caloric value. One pound of figs with 1,475 calories would, from the standpoint of growth and replacement of worn-out nitrogenous tissues, not be worth to the body as much as a pound of meat with 1,000 calories, but as a source of muscular energy the figs would be an excellent supplement to foods such as meat or fish.

Wide differences are found in the potential excess alkalinity of various fruits and vegetables. Dried figs have a considerably higher excess alkalinity than most other alkaline foods, and even fresh figs are more alkaline than are most fresh fruits and vegetables.

Figs have a high amount of calcium, the chief function of which is the building and maintenance of bone. Dried figs are rich in iron and also in copper, the latter having an important effect in stimulating blood production and therefore in preventing or curing nutritional anemias.

Recent studies of the vitamin content of figs show that fresh figs are good sources of vitamin C, but that very little of this vitamin is retained in the dried fruit. Fresh Mission figs are probably less well endowed with vitamin C than fresh Calimyrnas or Kadotas. They are probably richer in vitamin A than grapes, dates, or apples but considerably less rich than fresh apricots, peaches, and prunes. While sulfured Calimyrna figs retain relatively more vitamin A than unsulfured fruit, ordinary sulfuring is of little value so far as the retention of vitamin C is concerned.

Figs for Stock Feed.—In the fig districts of the Old World both fresh and dried figs are commonly used for stock feed, the price of dried fruit for this purpose depending upon the prices for oats and barley. Even the leaves of fig trees are harvested when they are mature and almost ready to drop, and stored or sold for fodder. Raisins lead other fresh and dried fruits in number of calories per pound, but 100 pounds of dried figs are reported to be equivalent to 186 pounds of wheat straw, to 110 of alfalfa hay, to 83 of corn, to 85 of barley, to 93 of oats, to 89 of wheat, to 97 of wheat bran, to 50 of cottonseed meal, or to 72 of coconut meal. However, it would require about 8 pounds of fresh figs to equal 1 pound of wheat with respect to protein.

ECONOMICS OF THE FIG INDUSTRY

Acreage.—The estimated acreage of fig trees of all varieties in California in 1932 was 46,129 acres bearing, and 4,518 nonbearing. In order of importance the bearing acreage of the leading fig-growing counties is as follows: Fresno, 19,916 acres; Merced, 9,475; Tulare, 5,751; San Joaquin, 1,914; Madera, 1,399; Yolo, 1,359; Stanislaus, 1,140 acres. The

TABLE 2*

PRODUCTION AND FARM VALUE OF FIGS DRIED AND SHIPPED FRESH FROM 1929 TO 1932

Year *	Production	Farm value	
		Per ton	Total
Figs marketed fresh			
	fresh tons		
1929	7,300	$100.00	$730,000
1930	7,700	90.00	693,000
1931	6,300	74.00	466,000
1932	6,000	38.00	228,000
Figs dried			
	dried tons		
1929	17,000	$90.00	$1,530,000
1930	21,000	48.00	1,008,000
1931	17,000	37.00	629,000
1932	17,000 { 12,000 at	34.00	480,000
	{ 5,000 at	5.00	25,000

* Figures from: California Cooperative Crop-reporting Service. Summary of California annual fruit and nut crop. 1931 and 1932 issues.

acreage in Kadota fig trees in 1932 is reported as 8,230 bearing and 2,993 nonbearing, the leading counties in order of their acreage being Merced, Fresno, Riverside, San Joaquin, Tulare, and Stanislaus. Specific figures on the Kadota acreage are available for the reason that many of the plantings were made in large tracts. Similar figures for the acreage planted to each of the other commercial varieties are not so readily estimated. It should be pointed out that hundreds of acres of figs, especially of the Calimyrna and Kadota varieties, are being neglected, so that they need not be seriously considered in future estimates of acreage or production.

The total acreage planted to figs in California increased rapidly during the past decade and a half, largely on account of the activities of

promoters. Between 1920 and 1925, for example, there was an increase of 156 per cent in the fig acreage, and between 1920 and 1930 the increase was 177 per cent. Production, however, did not keep pace with the acreage.

Production.—The production of dried figs during the five-year period ending in 1928 averaged 10,470 dried tons a year. The average annual production of figs for canning and fresh-fruit shipping during the same period was 4,368 fresh tons. Production of dried figs and of figs for the fresh-fruit market since 1929 is given in table 2.

TABLE 3

CALIFORNIA CANNED FIG PRODUCTION, 1922–1932*

Year	Calimyrna	Kadota		Total
	tons	*tons*	*cases*†	*tons*
1922	1,396	341	.....	1,737
1923	1,619	547	.....	2,366
1924	610	325	.....	935
1925	400	1,025	.....	1,425
1926	400	2,568	.....	2,968
1927	370	2,730	.....	3,100
1928	131	3,999	.....	4,130
1929	.....	3,895	223,857	3,895
1930	.....	4,132	237,600	4,132
1931	.....	1,347	77,482	1,347
1932	.....	2,566	147,573	2,566

* Early figures from California Peach and Fig Growers, Fresno; later figures from California Cooperative Crop-reporting Service.

† Figures issued by Canner's League of California. Kadota figs pack out from 55 to 60 cases to a ton of fresh fruit.

Carlot shipments of fresh figs from California gradually increased from 4 cars in 1919 to 116 cars in 1927. In 1928 total shipments dropped to 98 cars but increased again in 1930 to 110 cars. Cars of fresh figs shipped in 1931 and 1932 were respectively 67 and 46.

The Dried Fruit Association of California makes the following estimate of present dried-fig production in the state: Adriatic, 9,000 dried tons of which 7,000 tons test over 70 per cent; Calimyrna, 2,500 dried tons, 1,700 tons testing over 70 per cent; Mission, 2,000 dried tons; Kadota, 1,750 dried tons, with about 1,500 tons testing over 70 per cent.

The fact that the Kadota fig has almost entirely superseded the Calimyrna for canning purposes is emphasized by the figures in table 3.

Competition.—California canned figs compete in the consuming markets with Texas figs. A few years ago both the acreage and production of the Brunswick (Magnolia) in Texas exceeded that of the Kadota fig in this state. In both states, however, the canning-fig industry has suf-

fered severely from too rapid expansion of acreage, lack of market development, and poor demand for the product on account of the low buying power of the consuming public.

Only small quantities of fresh figs are shipped to eastern markets from districts outside of California.

Figs, both fresh and dried, naturally have to compete with other fruits for a place in the menu.[14] The annual average per-capita consumption of fruits and melons in the United States in the years 1925–1929 was about 220 pounds, fresh equivalent. Of this, figs constituted only about 1.5 pounds. The annual per-capita consumption of fresh and canned figs in the United States averaged about 0.2 pound, and of dried figs about 1.3 pounds on a fresh basis (at a conversion ratio of 3:1), or less than 0.5 pound dry weight.

The principal competition faced by the California grower comes in the form of dried figs imported from Mediterranean countries. For the decade preceding the World War imports of dried figs varied from about 7,000 to 12,000 tons annually. Following the War there was a marked increase in fig importations. They reached a maximum of 21,000 tons in each of the years ending June 30, 1922, 1925, and 1926. Since the year 1928–29 there has been a marked decline in the United States fig imports owing largely to an increased tariff and to more stringent pure food requirements. Net imports in 1929–30 totaled 8,885 tons, in 1930–31, 6,950 tons, and in 1931–32, 3,836. On June 17, 1930, the tariff on imported dried figs was raised from 2 cents a pound to 5 cents.

Costs of Production.—Very few detailed studies of costs of producing figs have been made as compared to those compiled for certain other fruits. Present costs of land and of fruit production are considerably below those prevailing a few years ago. Fig orchards now in bearing were commonly planted on land costing from $100 to $200 an acre, the cost of establishing the orchard being around $140 and the annual upkeep to producing age from $35 to $50 an acre.

Costs of producing Kadota figs for the 1926 season are given in Bulletin 436[15] and emphasize the fact that costs per pound markedly decrease as production per acre increases. Actual production costs in 1929 of a 40-acre Kadota orchard producing 207 tons of fresh figs and 21 tons of dried figs were as follows: pruning $15.72, cultivation $3.78, irrigation $3.75, fertilization $1.22, spraying $5.36, maintenance and repairs $4.02, general labor $4.12, depreciation $7.50, taxes and water

[14] See: Shear, S. W. Some aspects of the economic status of the fig industry. Proceedings of the 13th Annual Institute of Fig Growers of California. p. 36. 1929.

[15] Condit, Ira J. I. The Kadota fig. California Agr. Exp. Sta. Bul. 436:1–42. 1927. (Out of print.)

TABLE 4

COST OF PRODUCING DRIED FIGS*†

(Middle San Joaquin Valley)

Cultural practices		Labor, equipment, and material	Rate of work per 9-hour day	Unit cost	Seasonal cost per acre
Time of performance	Operations				
December 15–February	Pruning	Men; pruning shears, and saws	1.0 acre	$2.25 a man day	$2.25
	Piling brush	1 man	25.0 acres	2.00 a day	0.08
	Hauling and burning brush	3 men; 2 horses; wagon	18.0 acres	7.98 a day	0.44
March	Disking and cross disking	1 man; 10-hp. tractor; 5-ft. double disk	6.0 acres	10.04 a day	1.67
March–April 15	Cultivating (2 times)	1 man; 10-hp. tractor; 13½-ft. spring-tooth harrow	32.3 acres	9.09 a day	0.56
March–June	Hoeing and suckering	1 man	3.0 acres	2.00 a day	0.67
April 15–30	Furrowing and making head-ditches for irrigation (2 times)	1 man; 10-hp. tractor; 2 shovel furrower	12.0 acres	9.89 a day	1.64
April 15–July 15	Irrigating (3 times at 4 to 6-week intervals)	1 man	4.5 acres	2.00 a day	1.32
		Water, 1½ acre feet	.....	2.00 an acre ft.	3.00
August	Disking and cross-disking	1 man; 10-hp. tractor; 5-ft. double disk	6.0 acres	10.04 a day	1.67
	Harrowing and cross-harrowing	1 man; 10-hp. tractor; 20-ft. spike-tooth harrow	24.0 acres	8.97 a day	0.37
August 15–30	Dragging	1 man; 10-hp. tractor; 12-ft. plank drag	12.0 acres	$8.79 a day	0.73
	Pest control	Estimated average for labor and material	.....	.....	0.20
Total preharvest cost					$14.60

* Prepared by R. L. Adams.

† Calculated on gross yield of 3,000 pounds (dried weight) per acre, of which 1,800 pounds are No. 1 fruit and 1,200 pounds are culls. The orchard was mature and was planted at the rate of 27 trees per acre, on land which has been leveled and fitted for irrigation. Basic rates per 9-hour day were: hand labor and teamsters, $2.00; tractor operator, tree pruners, and dry-yard labor, $2.25; use of 10-hp. tractor, $6.48; use of horses, $0.81 each.

TABLE 4—*(Concluded)*

Cultural practices		Labor, equipment, and material	Rate of work per 9-hour day	Unit cost	Seasonal cost per acre
Time of performance	Operations				
September–November	Harvesting				
	Picking figs (2¼ tons green weight)	Contract		$0.15 per cwt.	$6.75
	Hauling to dry-yard	1 man; 2 horses; wagon	5 tons	4.48 a day	2.02
	Sorting	Contract		0.15 per cwt.	6.75
	Drying (includes spreading on trays, turning, sorting, stacking, and boxing)	Man—total of 18 man hours per ton (dried weight)		0.25 a man hr.	6.75
	Hauling to receiving station (1½ tons dried weight)	Contract		$1.00 a ton	1.50
Total harvest cost					$23.77

Additional charges	Seasonal cost
Charge for use of equipment (pruning shears and saw, ladders, drying trays (2 ft. x 3 ft.) sweat boxes, based on an investment per acre of $27.25, per acre	$ 2.88
Land charge (to cover depreciation of trees, taxes, and use of land), per acre	22.50
Management (on basis of $3,600 a year for 320 acres), per acre	11.25
Total gross cost per acre	$75.00
Credit—1,200 pounds cull figs at $5.00 a ton, per acre	3.00
Total net cost per acre	$72.00
Cost per pound of No. 1 fruit	$ 0.04

Cost of caprification (required for Smyrna-type varieties only)	
Profichi 2,000 figs at $7.50 per 1,000, cost per acre	$15.00
Distributing in orchard, 3 man hours at $0.25 an hour, cost per acre	0.75
Charge for use of caprifig baskets (annual charge made up of interest, depreciation, upkeep, and taxes on basis of an investment of $5.00 per acre), per acre	2.05
Total cost of caprification, per acre	$17.80
Additional cost per pound of No. 1 dried fruit	$ 0.09

costs $16.66, insurance $1.50, interest $15.54, other costs $13.36, making the total operating costs $92.50 per acre. The harvesting costs, including the picking up of dried figs, were $108.86 per acre.

According to Bulletin 388[16] the costs for picking and drying Calimyrna figs in 1921 were from $20 to $22 per ton, of which $8 to $10 a ton was paid for picking at the rate of 20 cents for each lug box of 40 to 50 pounds. The present rate is around 12 cents a lug box. The total cost of

TABLE 5

AVERAGE RETURNS PER DRIED POUND TO ASSOCIATION MEMBERS FOR THE FOUR YEARS 1920–1923 AND FOR 1928

	Adriatic and Kadota	Calimyrna	Mission
	cents per pound	*cents per pound*	*cents per pound*
1920	6.94	8.59	.....
1921	5.11	7.31	6.10
1922	4.49	6.53	8.93
1923	3.25	4.25	5.00
1928*	4.30	6.00	4.00

* 1928 figures from California Fruit News, January 18, 1930.

picking up and drying Adriatic figs at Fresno in 1921 was $22.25 a dry ton. At present materials and labor costs, a ton of Adriatic figs can be handled through the dry-yard for about one-half the above costs.

Table 4 shows the approximate costs of the various operations connected with the production of dried figs under present conditions. These figures cover specific cases and not "average."

Prices and Returns.—The average wholesale price for dried figs in 50-pound boxes from 1895 to 1914 was 4 cents a pound for white figs and 3.4 cents for black figs. During the World War the average wholesale price was 11.3 cents a pound for white and 9.8 cents for black figs. The amount received by the grower for white figs was about 1.75 cents less than the wholesale price and for black figs, 0.75 cents less. The peak of prices was reached in 1920 when some growers actually received 12 cents a dried pound for Mission, 15 cents for Adriatic, and 20 cents for Calimyrna figs. The average returns per pound to Association members for the four years, 1920–1923 and for 1928, are given in table 5.

During the past few years dried-fruit prices have been low, and many a fig grower is discouraged because he is not able to get for his crop an amount at least equal to the tariff, i.e., 5 cents a pound.

[16] Christie, A. W., and L. C. Barnard. The principles and practice of sun-drying fruit. California Agr. Exp. Sta. Bul. 388:1–60. 1925. (Out of print.)

Growers' returns for canning figs have likewise slumped. In 1925 prices were generally 5 cents a pound, and in 1926, 6 cents a pound for No. 1 figs. The 1927 price dropped back to 5 cents a pound in some sections and to 4 cents in others. Canners paid 4 cents in 1928 and 4½ or 5 cents in 1929. While in 1932 some growers received from 2 to 3 cents a pound for limited tonnages of first-grade figs, the culling of the delivered fruit was so heavy in most cases that actual receipts averaged considerably lower than the prices stated.

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